PHILIPS

DATA HANDBOOK

PHILIPS ELECTRONIC COMPONENTS AND MATERIALS

SEMICONDUCTORS AND INTEGRATED CIRCUITS

PART 1 SEPTEMBER 1970

Signal diodes

Tunnel diodes

Variable capacitance diodes

Voltage regulator diodes

Rectifier diodes

Thyristors, diacs, triacs

Rectifier stacks

Accessories

Heatsinks

SEMICONDUCTORS AND INTEGRATED CIRCUITS

Part 1 **September 1970**

DATA HANDBOOK SYSTEM

To provide you with a comprehensive source of information on electronic components, subassemblies and materials, our Data Handbook System is made up of three series of handbooks, each comprising several parts.
The three series, identified by the colours noted, are:

ELECTRON TUBES (9 parts)	BLUE
SEMICONDUCTORS AND INTEGRATED CIRCUITS (5 parts)	RED
COMPONENTS AND MATERIALS (5 parts)	GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued annually; the contents of each series are summarized on the following pages.
We have made every effort to ensure that each series is as accurate, comprehensive and up-to-date as possible, and we hope you will find it to be a valuable source of reference. Where ratings or specifications quoted differ from those published in the preceding edition they will be pointed out by arrows. You will understand that we can not guarantee that all products listed in any one edition of the handbook will remain available, or that their specifications will not be changed, before the next edition is published. If you need confirmation that the pusblished data about any of our products are the latest available, may we ask that you contact our representative. He is at your service and will be glad to answer your inquiries.

January 1970

ELECTRON TUBES (BLUE SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 — **January 1970**

Transmitting tubes (Tetrodes, Pentodes)
Associated accessories

Part 2 — **February 1970**

Tubes for microwave equipment

Part 3 — **March 1970**

Special Quality tubes
Miscellaneous devices

Part 4 — **April 1970**

Receiving tubes

Part 5 — **May 1970**

Cathode-ray tubes
Photo tubes
Camera tubes
Photoconductive devices
Associated accessories

Part 6 — **June 1970**

Photomultiplier tubes
Scintillators
Photoscintillators
Radiation counter tubes
Semiconductor radiation detectors
Neutron generator tubes
Associated accessories

Part 7 — **July 1970**

Voltage stabilizing and reference tubes
Counter, selector, and indicator tubes
Trigger tubes
Switching diodes
Thyratrons
Ignitrons
Industrial rectifying tubes
High-voltage rectifying tubes

Part 8 — **August 1970**

T.V. Picture tubes

Part 9 — **December 1969**

Transmitting tubes (Triodes)
Tubes for R.F. heating (Triodes)
Associated accessories

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 Diodes and Thyristors **September 1970**

General
Signal diodes
Tunnel diodes
Variable capacitance diodes
Voltage regulator diodes
Rectifier diodes
Thyristors, diacs, triacs
Rectifier stacks
Accessories
Heatsinks

Part 2 Low frequency; Deflection **October 1969**

General
Low frequency transistors (low power)
Low frequency power transistors
Deflection transistors
Accessories

Part 3 High frequency; Switching **November 1969**

General
High frequency transistors
Switching transistors
Accessories

Part 4 Special types **December 1969**

General
Transmitting transistors
Field effect transistors
Dual transistors
Diodes and transistors for thick-and thin-film circuits
Photo devices
Accessories

Part 5 Integrated Circuits. **February 1970**

General
Digital integrated circuits
- FC family; standard temperature range
- FC family; extended temperature range
- FD family
- FJ family; standard temperature range

Linear integrated circuits

COMPONENTS AND MATERIALS (GREEN SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 Circuit Blocks, Input/Output Devices **September 1969**

Circuit blocks 100kHz Series
Circuit blocks 1-Series
Circuit blocks 10-Series
Circuit blocks 20-Series
Circuit blocks 40- Series
Counter modules 50-Series
Norbits 60-Series
Circuit blocks for ferrite core memory drive
Input/output devices

Part 2 Resistors, Capacitors **November 1969**

Fixed resistors
Variable resistors
Non-linear resistors
Ceramic capacitors
Polycarbonate, paper, mica, polystyrene capacitors
Electrolytic capacitors
Variable capacitors

Part 3 Radio, Audio, Television **January 1970**

FM tuners
Coils
Piezoelectric ceramic resonators and filters
Loudspeakers
Electronic organ assemblies
Television tuners
Components for black and white television
Components for colour television
Deflection assemblies for camera tubes
Audio and mains transformers

Part 4 Magnetic Materials, White Ceramics **March 1970**

Ferrites for radio, audio and television
Ferroxcube potcores and square cores
Microchokes
Ferroxcube transformer cores
Piezoxide
Permanent magnet materials

Part 5 Memory Products, Magnetic Heads, Quartz Crystals, Microwave Devices, Variable Transformers, Electro-mechanical Components **June 1970**

Ferrite memory cores
Matrix planes, matrix stacks
Complete memories
Magnetic heads
Quartz crystal units, crystal filters
Isolators, circulators
Variable mains transformers
Electro-mechanical components

General

Type designation
Colour codes
Rating systems
Letter symbols

PRO ELECTRON TYPE DESIGNATION CODE

FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete devices and to multiple devices [1])

The type designation consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

The first letter gives an indication of the material

A Material with a band gap of 0.6 to 1.0 eV, such as germanium

B Material with a band gap of 1.0 to 1.3 eV, such as silicon

C Material with a band gap of 1.3 eV and more, such as gallium arsenide

D Material with a band gap of less than 0.6 eV, such as indium antimonide

R Compound material as 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.

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

A Detection diode, switching diode, mixer diode

B Variable capacitance diode

C Transistor for a.f. applications ($R_{th\ j\text{-}mb} > 15\ ^oC/W$)

D Power transistor for a.f. applications ($R_{th\ j\text{-}mb} \leq 15\ ^oC/W$)

E Tunnel diode

F Transistor for h.f. applications ($R_{th\ j\text{-}mb} > 15\ ^oC/W$)

G Multiple of dissimilar devices (see note on page 1); Miscellaneous

H Magnetic sensitive diode; Field probe

K Hall generator in an open magnetic circuit, e.g. magnetogram or signal probe

L Power transistor for h.f. applications ($R_{th\ j\text{-}mb} \leq 15\ ^oC/W$)

M Hall generator in a closed electrically energised magnetic circuit, e.g. Hall modulator or multiplier

P Radiation sensitive device [1)]

Q Radiation generating device

R Electrically triggered controlling and switching device having a break-down characteristic ($R_{th\ j\text{-}mb} > 15\ ^oC/W$)

S Transistor for switching applications ($R_{th\ j\text{-}mb} > 15\ ^oC/W$)

T Electrically, or by means of light, triggered controlling and switching power device having a breakdown characteristic ($R_{th\ j\text{-}mb} \leq 15\ ^oC/W$) [1)]

U Power transistor for switching applications ($R_{th\ j\text{-}mb} \leq 15\ ^oC/W$)

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.

The serial number consists of:

Three figures for semiconductor devices designed primarily for use in domestic equipment

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

VERSION LETTER

A version letter can be used, for instance, for a diode with up-rated voltage, for a sub-division of a transistor type in different gain ranges, a low noise version of an existing transistor and for a diode, transistor, or thyristor with minor mechanical differences, such as finish of the leads, length of the leads etc. The letters never have a fixed meaning, the only exception being the letter R.

EXAMPLES

AC187	Germanium low power a.f. transistor intended primarily for domestic equipment
BYX27	Silicon rectifying diode intended primarily for professional equipment

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)

d) radiation detectors

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 generally indicates the maximum repetitive peak reverse voltage
For controlled avalanche types it indicates the maximum crest working reverse voltage

c) for thyristors

a number and where appropriate the letter R [1])
The number generally indicates either the maximum repetitive peak reverse voltage or the maximum repetitive peak off-state voltage, whichever is lower
For controlled avalanche types it indicates the maximum crest working reverse voltage

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

d) for radiation detectors

a figure giving the depth of the depletion layer in μm and where appropriate a version letter if there are differences in resolution.

EXAMPLES

BZY88series	Range of silicon voltage regulator diodes for professional equipment
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
BTX64-200R	The particular reverse polarity type out of the BTX64 thyristor range of which the lower maximum repetitive peak voltage is 200 V

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.

Pro-Electron type numbers of whiskerless diodes

letters

Types in SOD-17 envelopes are identified by the colour of the cathode stud (not coloured for BAX) and a black body.
Types in SOD-27 (DO-35) by a light background colour.

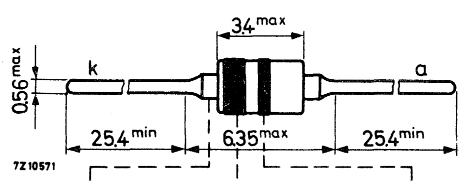
digits

Numbers are indicated by bands.
The broadest band indicates the cathode, its colour the first digit.
The colour of the second band indicates the second digit.

colour	letters SOD-17 (cathode stud)	letters SOD-27 (background)	digit
not coloured	BAX	–	–
black	–	–	0
brown	–	BAS	1
red	BA	–	2
orange	–	–	3
yellow	–	BAT	4
green	–	BAV	5
blue	–	BAW	6
violet	–	–	7
grey	–	–	8
white	–	–	9

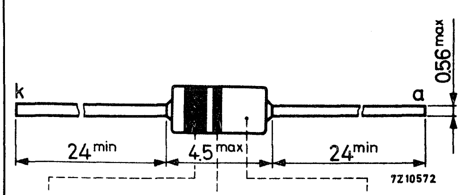
Examples

BAX13 in SOD-17 envelope



not coloured | brown | orange
BAX | 1 | 3

BAW62 in SOD-27 envelope
(DO-35)



blue | red | body colour light blue
6 | 2 | BAW

JEDEC assigned type numbers

(EIA-standard RS-236-B; June, 1963)

1. Prefix identification

The prefix identification consisting of a first number symbol and the letter "N" shall not be indicated in the coding.

2. Banding systems

The sequence number consisting of a two, three, or four digit number after the letter "N" may be coded as follows:

2.1 Two-digit sequence numbers shall consist of a first black band and the sequence number in second and third bands of the colours indicated in Table 1. If a suffix letter is required, it shall be indicated with a fourth band as indicated in Table 1.

2.2 Three-digit sequence numbers shall consist of the sequence number in first, second, and third bands of the colours indicated in Table 1. If a suffix letter is required, it shall be indicated with a fourth band as indicated in Table 1.

2.3 Four-digit sequence numbers shall consist of the sequence number in four bands of the colours indicated in Table 1 with a fifth black band. If a suffix letter is required it shall be indicated as the fifth band and shall replace the black band.

3. Cathode identification and reading sequence

3.1 A double-width band shall be used as the first band reading from cathode to anode ends.

3.2 An alternative method is provided where equal width bands may be used. The bands shall be clearly grouped toward the cathode end, and shall be read from cathode to anode ends.

3.3 Either of the above colour banding methods may be used in stead of the cathode designating symbol or other marking.

4. Colour bands

The sequence numbers of the type numbers and suffix letters shall be indicated by the colours in Table 1.

TABLE 1

NUMBER	COLOUR	SUFFIX LETTER
0	black	not applicable
1	brown	A
2	red	B
3	orange	C
4	yellow	D
5	green	E
6	blue	F
7	violet	G
8	grey	H
9	white	J

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.

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.

LETTER SYMBOLS

LETTER SYMBOLS FOR SEMICONDUCTOR DEVICES
excluding rectifier diodes, thyristors and integrated circuits

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}, $I_{C(AV)}$, 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) or (rms)

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

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

A, a	= Anode terminal
K, k	= Cathode terminal
E, e	= Emitter terminal
B, b	= Base terminal or Substrate for MOS devices
C, c	= Collector terminal
D, d	= Drain terminal
(BR)	= Break-down
X, x	= Specified circuit
M, m	= Maximum (peak) value
(AV), (av)	= Average value
(RMS), (rms)	= R.M.S. value
F, f	= Forward
G, g	= Gate terminal
R, r	= As first subscript: Reverse. As second subscript: Repetitive
O, o	= As third subscript: The terminal not mentioned is open circuited
S, s	= As first or second subscript: Source terminal (for FETS only) As second subscript: Non-repetitive (not for FETS) As third subscript : Short circuit between the terminal not mentioned and the reference terminal
Z, 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.

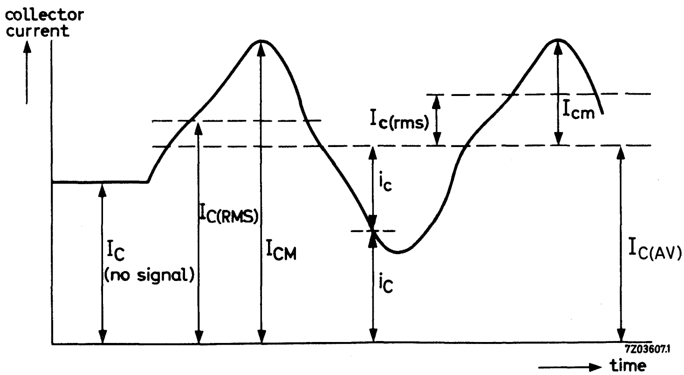


Fig.1

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.

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.

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

LIST OF LETTER SYMBOLS IN ALPHABETICAL ORDER

Letter symbol	Definition
B	Bandwidth
b_{ib}, b_{ie}, b_{is}, b_{fb}, b_{fe}, b_{fs}, b_{ob}, b_{oe}, b_{os}, b_{rb}, b_{re}, b_{rs}.	See y parameters
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_{is}, C_{fb} C_{fe}, C_{fs}, C_{ob}, C_{oe} C_{os}, C_{rb}, C_{re}, C_{rs}	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
G_v	Voltage gain

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

Letter symbol	Definition
h_{FB}, h_{FC}, h_{FE}	D.C. current gain (static value of the forward current transfer ratio; output voltage held constant)
h_{fb}, h_{fc}, h_{fe}	Small-signal current gain (small-signal value of the forward current transfer ratio; 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.)
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_D, I_E, I_G, I_S	Total d.c. (or average) current
I_b, I_c, I_d, I_e, I_g, I_s	Varying component of the current
i_B, i_C, i_D, i_E, i_G, i_S	Instantaneous total value of the current
i_b, i_c, i_d, i_e, i_g, i_s	Instantaneous value of the varying component of the current
$I_{B(AV)}$, $I_{C(AV)}$, $I_{E(AV)}$	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)

Letter symbol	Definition
I_{DSS}	Drain current (source short-circuited to gate)
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
$I_{F(AV)}$	Total average forward current of a diode (to distinguish between average and d.c. if necessary)
I_{FM}	Peak forward current of a diode
I_{GSS}	Gate cut-off current (source short-circuited to drain)
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_{SDS}	Source cut-off current (drain short-circuited to gate)
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	Reverse recovery charge

Letter symbol	Definition
r_D	Diode (internal) series resistance
r_{DS}	Drain-source resistance
r_{GS}	Gate-source resistance
R_L	Load 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 (contact thermal resistance)
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
t_d ; t_f	Delay time; 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

Letter symbols	Definition
V_{BEfl}	Base-emitter floating voltage (open base)
V_{BEsat}	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_{DGO}, V_{EBO}, V_{GSO}	Voltage of the terminal indicated by the first subscript w.r.t. the reference terminal (second subscript) with the third terminal open circuited
V_{CBOM}, V_{CEOM}	Peak value of V_{CBO}, V_{CEO}
V_{CEK}	Knee voltage at specified conditions
V_{CER}	Collector-emitter voltage with a specified resistance between emitter and base
V_{CERM}	Peak value of V_{CER}
V_{CES}	Collector-emitter voltage with the emitter short circuited to the base
V_{CEsat}	Saturation voltage at specified bottoming conditions
$V_{CE.sust}$	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_{DSS}	Drain-source voltage with the source short-circuited to the gate
V_{EBfl}	Emitter-base floating voltage (open emitter)
V_F	Continuous forward voltage of a diode
V_{FM}	Peak forward voltage of a diode

Letter symbol	Definition	
V_i, V_o	Input, respectively output voltage of a specified circuit	
$V_{(P)GS}$	Gate-source cut-off 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}, y_{is}	Input admittance	Output short circuited to a.c.
b_{ib}, b_{ie}, b_{is}		
g_{ib}, g_{ie}, g_{is}	Input conductance	
C_{ib}, C_{ie}, C_{is}	Input capacitance	
φ_{ib}, φ_{ie}, φ_{is}	Phase angle of input admittance	
y_{fb}, y_{fe}, y_{fs}	Transfer admittance	Output short circuited to a.c.
b_{fb}, b_{fe}, b_{fs}		
g_{fb}, g_{fe}, g_{fs}	Transfer conductance	
C_{fb}, C_{fe}, C_{fs}	Transfer capacitance	
φ_{fb}, φ_{fe}, φ_{fs}	Phase angle of transfer admittance	
y_{ob}, y_{oe}, y_{os}	Output admittance	Input short circuited to a.c.
b_{ob}, b_{oe}, b_{os}		
g_{ob}, g_{oe}, g_{os}	Output conductance	
C_{ob}, C_{oe}, C_{os}	Output capacitance	
φ_{ob}, φ_{oe}, φ_{os}	Phase angle of output admittance	
y_{rb}, y_{re}, y_{rs}	Feedback admittance	Input short circuited to a.c.
b_{rb}, b_{re}, b_{rs}		
g_{rb}, g_{re}, g_{rs}	Feedback conductance	
C_{rb}, C_{re}, C_{rs}	Feedback capacitance	
φ_{rb}, φ_{re}, φ_{rs}	Phase angle of feedback admittance	
Z_{th}	Transient thermal impedance	

LETTER SYMBOLS
FOR RECTIFIER 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 or crest), average, d.c. and root-mean-square values are represented by the appropriate upper case letter.

   Examples: I, V, P

SUBSCRIPTS FOR QUANTITY SYMBOLS

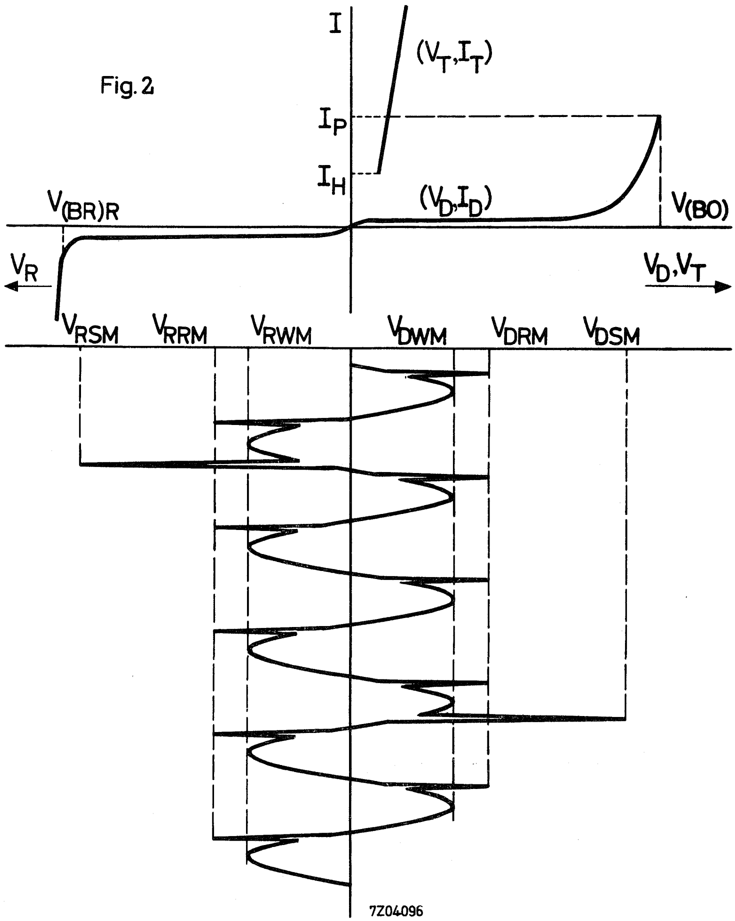
1. Total values are indicated by upper case subscripts.
2. Values of varying components are indicated by lower case subscripts.
3. For power rectifier diodes and thyristors the **terminals** are not indicated in the subscripts, except for the gate-terminal of thyristors.
4. List of subscripts:

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), (rms)	=	R.M.S. value
(BR)	=	Breakdown
(BO)	=	Breakover
H	=	Holding
L	=	Latching
Q, q	=	Turn-off
S, 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).

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



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_L	-	T	Latching current (Pick up current, I_P)
I_R	R	T	Reverse current (d.c.)
I_{RG}	-	T	Reverse gate current
I_{RRM}	R	T	Repetitive peak reverse current
I^2t	R	T	I squared t for fusing
I_T	-	T	On-state current (d.c.)
$\frac{dI_T}{dt}$	-	T	Rate of rise of on-state current
I_{TAV}	-	T	Average on-state current
$I_{T(RMS)}$	-	T	R.M.S. value of the on-state current
I_{TRM}	-	T	Repetitive peak on-state current
I_{TSM}	-	T	Non-repetitive peak on-state current
$I_{TS(RMS)}$	-	T	R.M.S. value of the non-repetitive 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

Letter symbol	R	T	Description
P_{RRM}	R	T	Repetitive peak reverse power dissipation
P_{RSM}	R	T	Non-repetitive peak reverse power dissipation
R_{th}	R	T	Thermal resistance
T_{amb}	R	T	Ambient temperature
T_{mb}	R	T	Mounting base temperature
t_d; t_f	R	T	Delay time; fall time
T_j	R	T	Junction temperature
t_q	R	T	Turn-off time
t_{on}	R	T	Turn-on time ($t_{on} = t_d + t_r$)
t_r	R	T	Rise time
T_{stg}	R	T	Storage temperature
$V_{(BO)}$	-	T	Breakover voltage
$V_{(BR)R}$	R	T	Reverse avalanche breakdown voltage
V_D	-	T	Continuous off-state voltage
$\frac{dV_D}{dt}$	-	T	Rate of rise of 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 on-state voltage
Z_{th}	R	T	Transient thermal impedance

Signal diodes

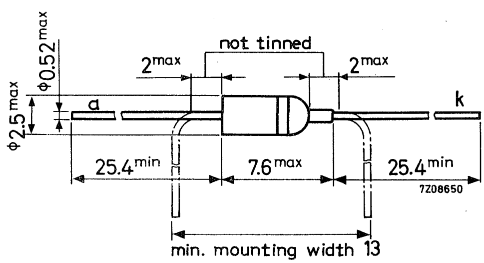
POINT CONTACT DIODE

Germanium point contact diode in a subminiature all glass DO-7 envelope primarily intended for use in a.m. detector and ratio detector circuits.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	45	V
Forward current (d.c.)	I_F	max.	35	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Operating ambient temperature	T_{amb}	max.	60	^oC
Forward voltage at I_F = 10 mA	V_F	<	2.2	V

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode

7Z3 2066

RATINGS (Limiting values) [1])

Voltages

Continuous reverse voltage	V_R	max.	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	45	V

Currents

Forward current (d.c.)	I_F	max.	35	mA
Average rectified forward current (averaged over any 50 ms period)	I_{FAV}	max.	35	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	200	mA

Temperatures

Storage temperature	T_{stg}		−55 to +75	°C
Operating ambient temperature	T_{amb}	max.	60	°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 1181

CHARACTERISTICS

Forward voltage at T_{amb} = 25 °C

I_F = 0.1 mA	V_F	typ.	0.23	V
		<	0.30	V
I_F = 1 mA	V_F	typ.	0.56	V
		<	0.88	V
I_F = 10 mA	V_F	typ.	1.5	V
		<	2.2	V
I_F = 30 mA [1]	V_F	typ.	2.8	V
		<	4.0	V

Forward voltage at T_{amb} = 60 °C

I_F = 0.1 mA	V_F	typ.	0.16	V
		<	0.25	V
I_F = 1 mA	V_F	typ.	0.50	V
		<	0.80	V
I_F = 10 mA	V_F	typ.	1.4	V
		<	2.1	V
I_F = 30 mA [1]	V_F	typ.	2.6	V
		<	3.8	V

Reverse current at T_{amb} = 25 °C

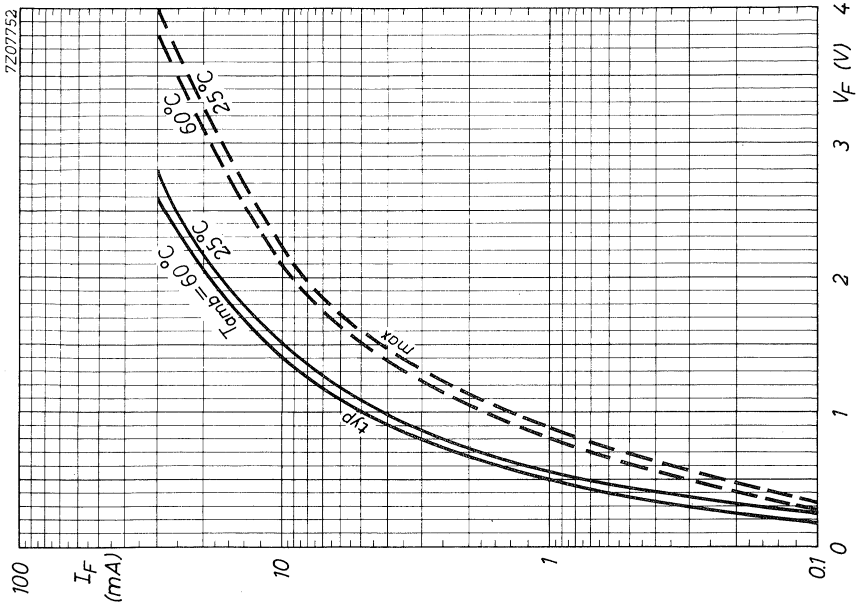
V_R = 0.1 V	I_R	typ.	0.35	µA
		<	1.0	µA
V_R = 1.5 V	I_R	typ.	0.8	µA
		<	2.8	µA
V_R = 10 v	I_R	typ.	4.5	µA
		<	18	µA
V_R = 30 V	I_R	typ.	35	µA
		<	150	µA
V_R = 45 V	I_R	typ.	90	µA
		<	350	µA

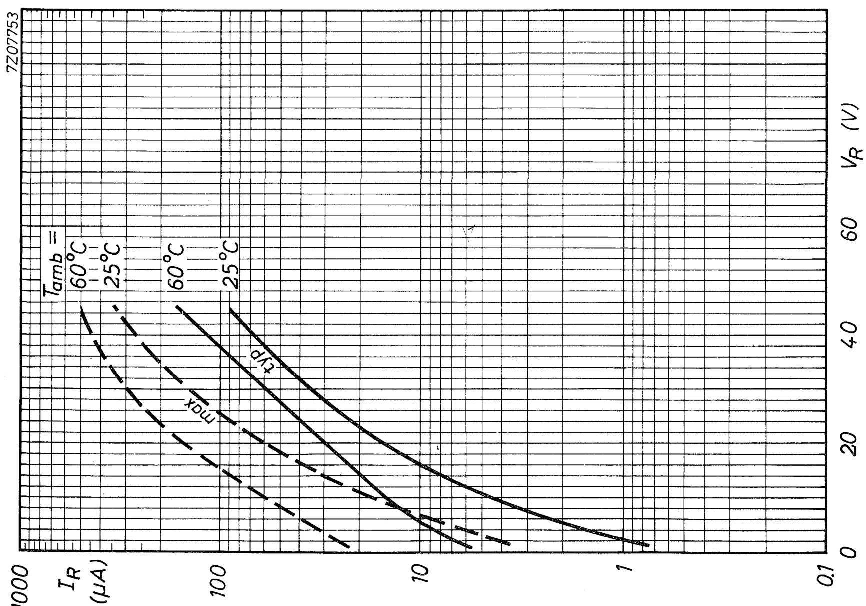
Reverse current at T_{amb} = 60 °C

V_R = 0.1 V	I_R	typ.	4.5	µA
		<	12	µA
V_R = 1.5 V	I_R	typ.	6	µA
		<	25	µA
V_R = 10 V	I_R	typ.	16	µA
		<	60	µA
V_R = 30 V	I_R	typ.	60	µA
		<	300	µA
V_R = 45 V	I_R	typ.	170	µA
		<	500	µA

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

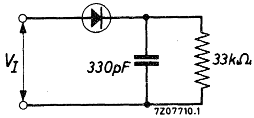
7Z3 1182


7Z07752
V_F (V)
I_F (mA)
$T_{amb} = 60\ °C$
25 °C
60 °C
25 °C
max
typ
100
10
1
0.1
0
1
2
3
4


7Z07753
V_R (V)
I_R (μA)
$T_{amb} =$
60°C
25°C
60°C
25°C
max
typ
1000
100
10
1
0.1
0
20
40
60

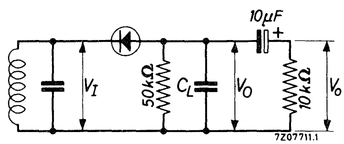
APPLICATION INFORMATION

Measuring circuit at T_{amb} = 25 °C



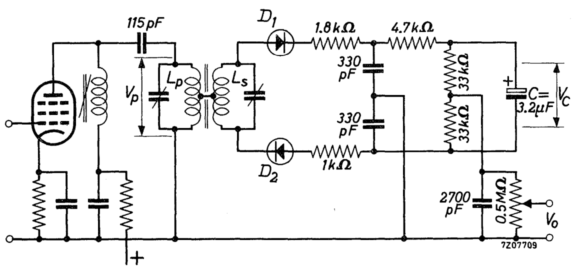
$V_{I(RMS)}$	= 3	V	η	typ.	85	%
f	= 10.7	MHz	R_d	typ.	15	kΩ
				13.5 to 19		kΩ

Diode in an a.m. detector circuit at T_{amb} = 25 °C



$V_{I(RMS)}$	= 0.1 V	V_O	typ. 55	mV	
f	= 0.5 MHz	$V_{o(rms)}$	typ. 4.5	mV	[1]
		R	typ. 40	kΩ	[2]

Matched pair in a ratio detector circuit



L_p	=	7.4	µH
Q_0	=	80	unloaded
R	=	40	kΩ unloaded
Tap	=	0.5	
L_s	=	4.4	µH
Q_0	=	150	unloaded
R	=	45	kΩ unloaded
kQ	=	0.8 [3]	
f_0	=	10.7	MHz
Δf	=	15	kHz
m	=	0.3	

a.m. suppression factor at V_C = 2 to 20 V

$f = f_0$	α	$\geq$	30
$f = f_0 \pm 25$ kHz	α	$\geq$	15

For optimum a.m. suppression D_1 must be that diode of the matched pair which has the better dynamic forward characteristic.

---

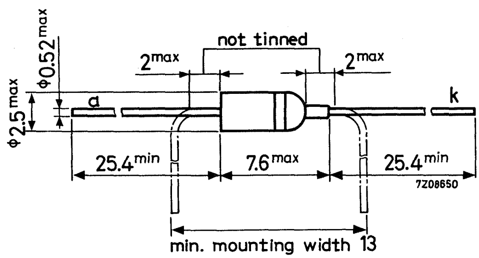
[1]) Modulation factor m = 0.3
[2]) Modulation factor m = 0
[3]) Measured in the circuit with V_p = 350 mV

POINT CONTACT DIODE

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

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS (Limiting values according to the Absolute Maximum System as dened in IEC publication 134)

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
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current	I_{FSM}	max.	200	mA

Temperatures

Storage temperature	T_{stg}		-55 to +75	^oC
Junction temperature	T_j	max.	75	^oC

THERMAL RESISTANCE

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

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

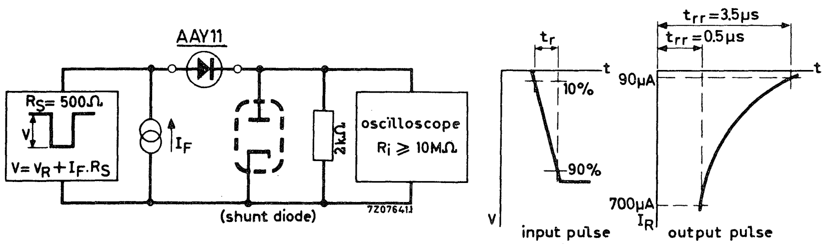
Reverse current

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

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:

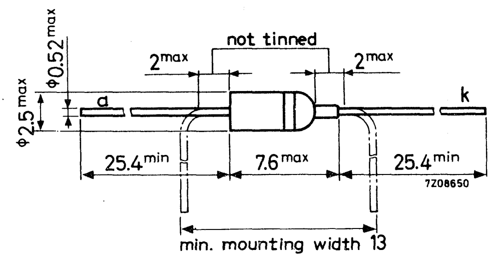
Rise time	t_r	≤	0.1	μs
Duty cycle	δ	=	0.5	
Frequency	f	=	50	kHz
Circuit capacitance	C	≤	30	pF (C = Oscilloscope + parasitical capacitance)

POINT CONTACT DIODE

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

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS (Limiting values according to the Absolute Maximum System as defined in IEC publication 134)

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	$^oC/mW$

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

Forward voltage

$I_F = 2$ mA	V_F	0.25 to 0.45 V
$I_F = 2$ mA; $T_j = 60\ ^{o}C$	V_F	0.19 to 0.39 V
$I_F = 10$ mA	V_F	0.40 to 0.80 V
$I_F = 10$ mA; $T_j = 60\ ^{o}C$	V_F	0.34 to 0.74 V
$I_F = 50$ mA	V_F	0.60 to 1.5 V
$I_F = 50$ mA; $T_j = 60\ ^{o}C$	V_F	0.54 to 1.44 V

Reverse current

$V_R = 5$ V; $T_{amb} = 60\ ^{o}C$	I_R	<	30	μA
$V_R = 5$ V; $T_{amb} = 25\ ^{o}C$	I_R	<	10	μA
$V_R = 15$ V; $T_{amb} = 60\ ^{o}C$	I_R	<	100	μA
$V_R = 15$ V; $T_{amb} = 25\ ^{o}C$	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; $R_L = 100\ \Omega$				
measured at $I_R = 1$ mA	t_{rr}	typ.	5	ns
		<	12	ns

GOLD BONDED DIODES

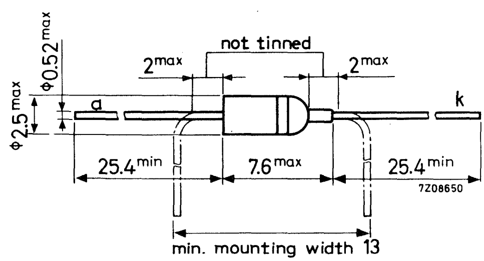
Gold bonded germanium diodes in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

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 coloured band indicates the cathode

RATINGS (Limiting values) [1])

Voltages			AAY30	AAY32	
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.

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

Reverse current at T_j = 25 °C

			AAY30	AAY32	
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

			AAY30	AAY32	
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

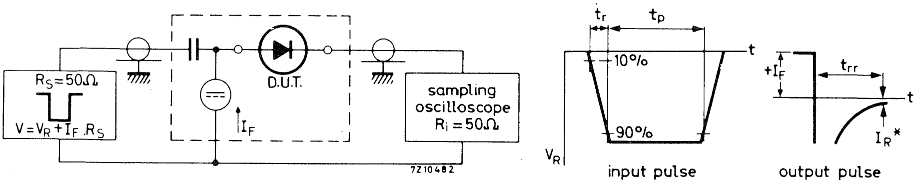
			AAY30	AAY32	
V_R = 1 V; f = 1 MHz	C_d	<	1.0	1.5	pF

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:



*) $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

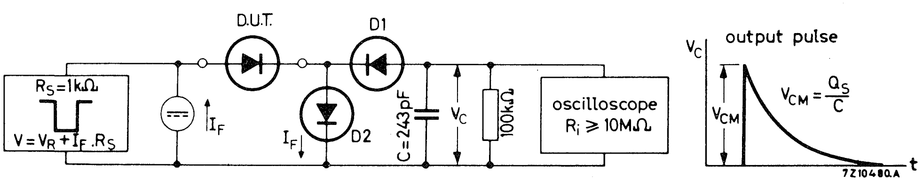
Reverse pulse:	Rise time	t_r =	0.6	ns
	Pulse duration	t_p =	100	ns
	Duty cycle	δ =	0.05	

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

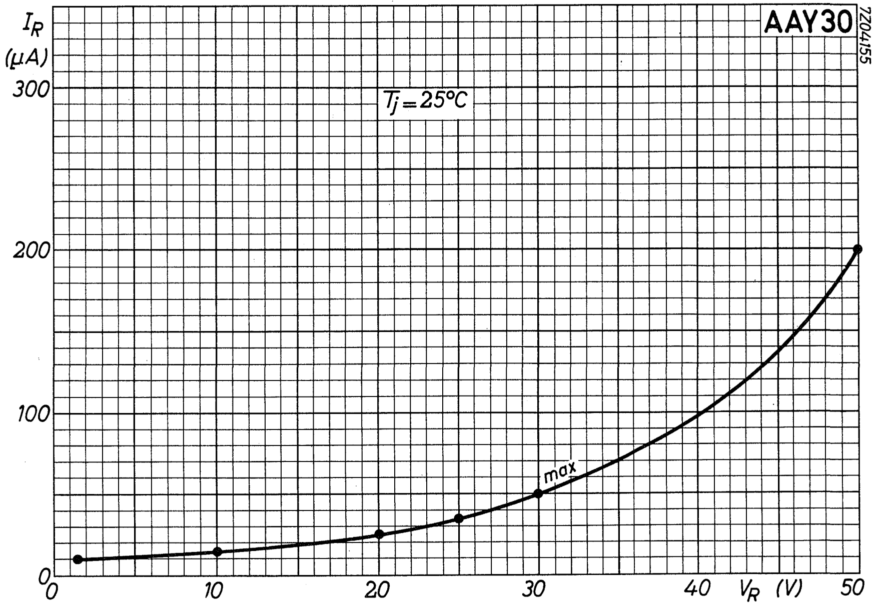
AAY30	Q_s	<	500	pC
AAY32	Q_s	<	150	pC

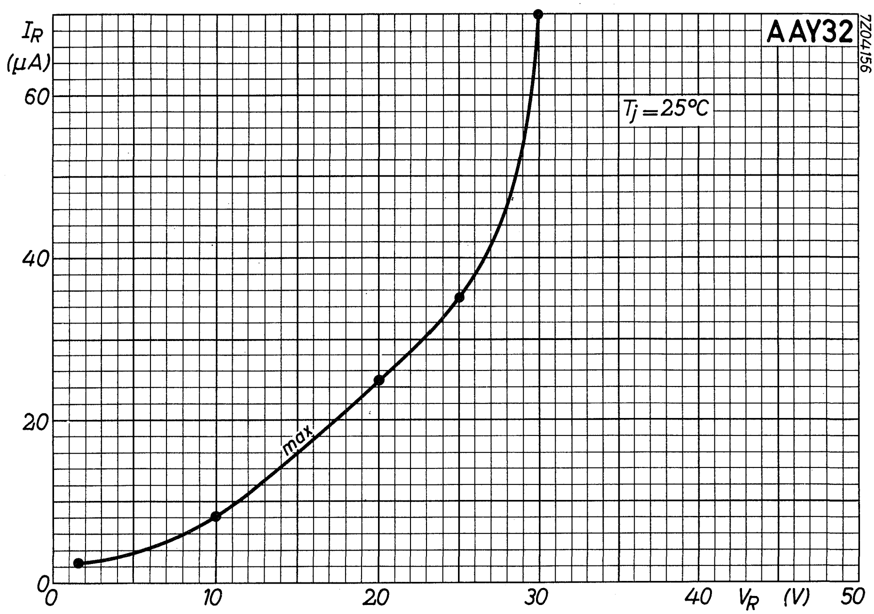
Test circuit:

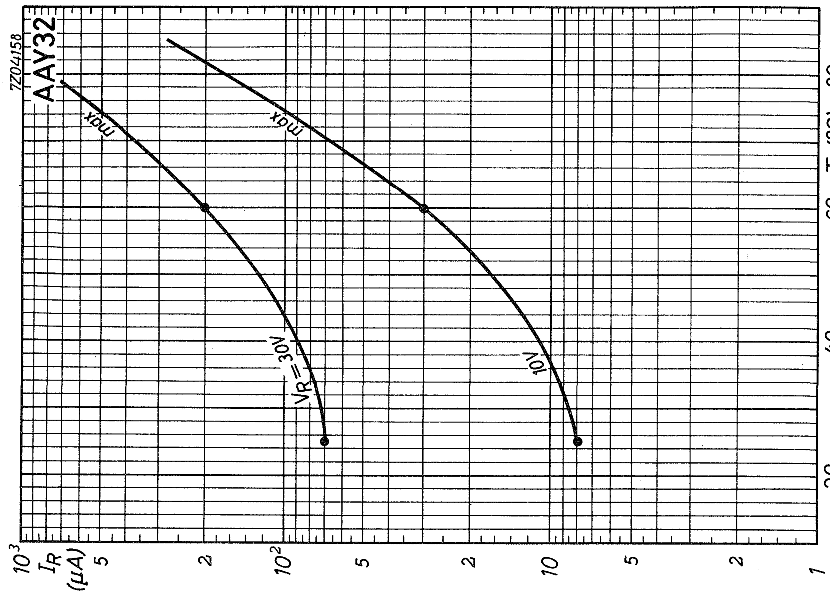


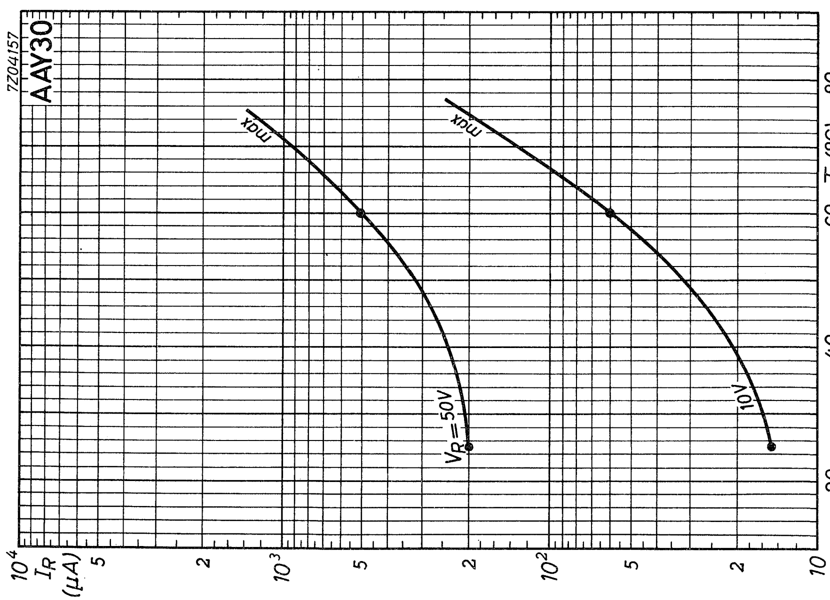
D1 = D2 = BAW62

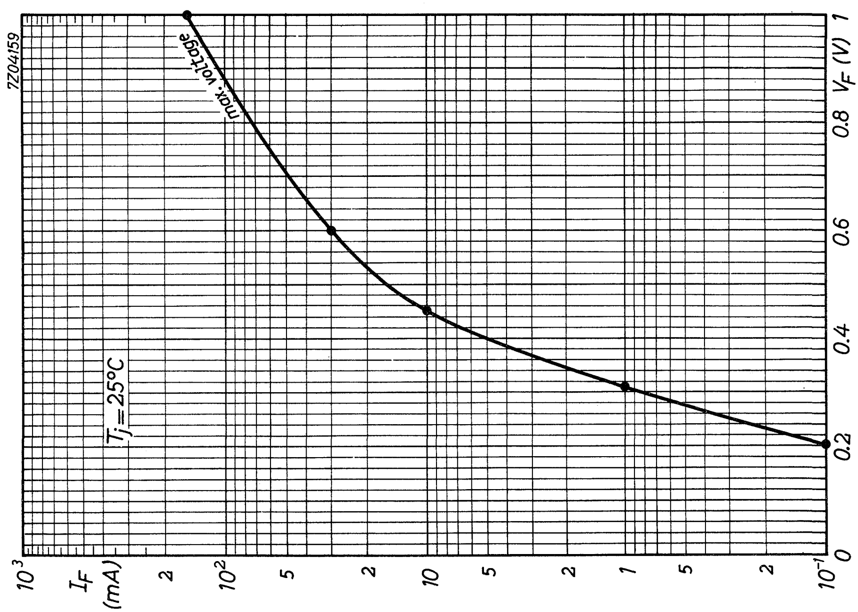
Reverse pulse:	Rise time	t_r =	2	ns
	Pulse duration	t_p =	0.4	μs
	Duty cycle	δ =	0.02	

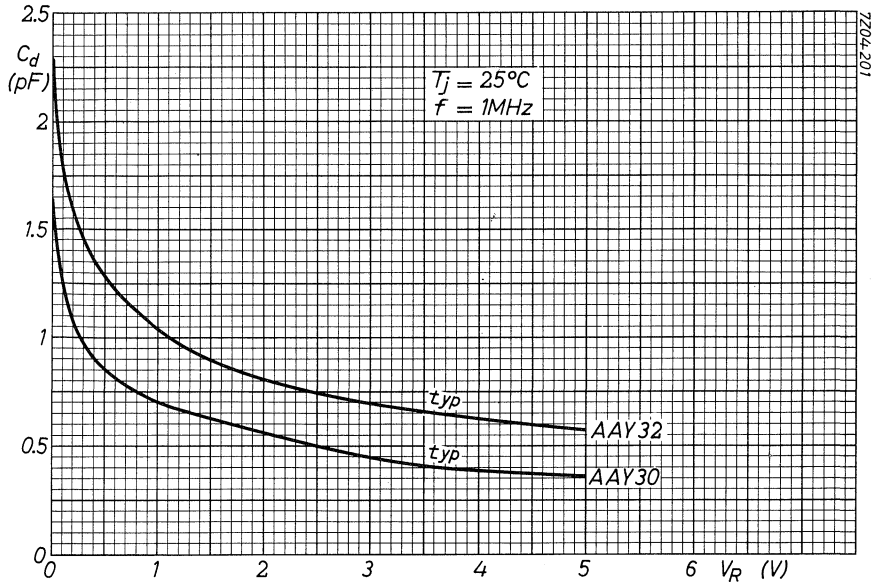

I_R (μA)
300
200
100
0
AAY30
7Z04155
$T_j = 25\,^\circ C$
max
0
10
20
30
40
V_R (V)
50

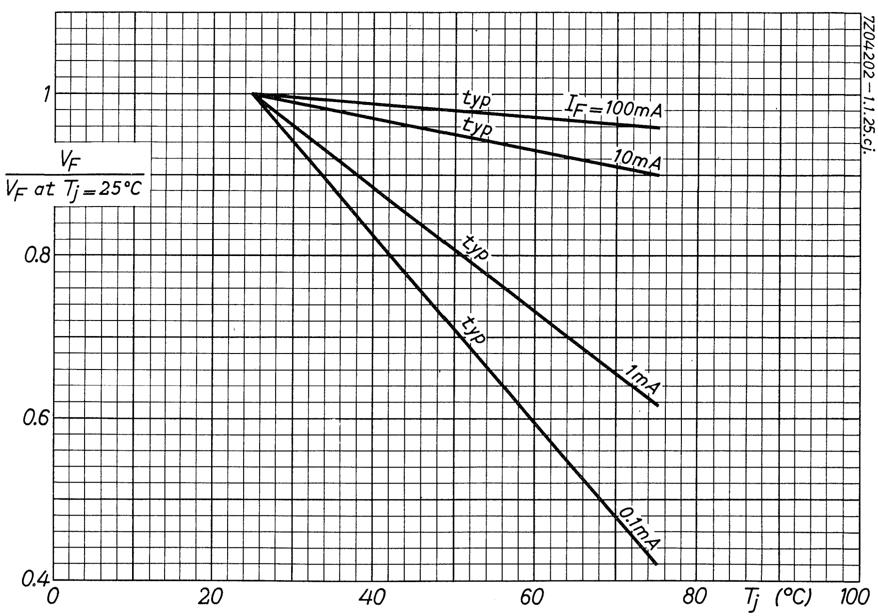

I_R (μA)
60
40
20
0
AAY32
7Z04156
$T_j = 25\,^\circ C$
max
0
10
20
30
40
V_R (V)
50

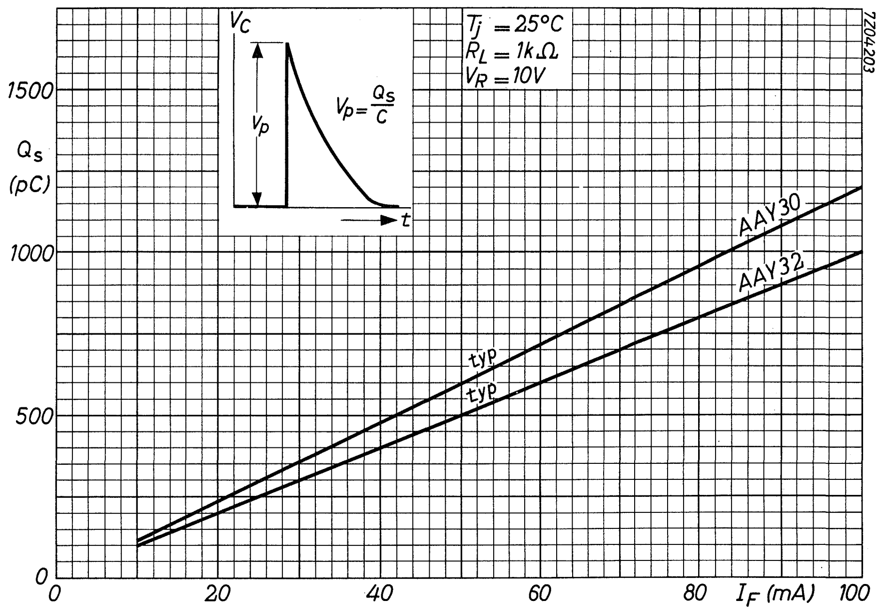

7Z04158
AAY32
max
max
$V_R = 30V$
10V
T_j (°C)
I_R (μA)

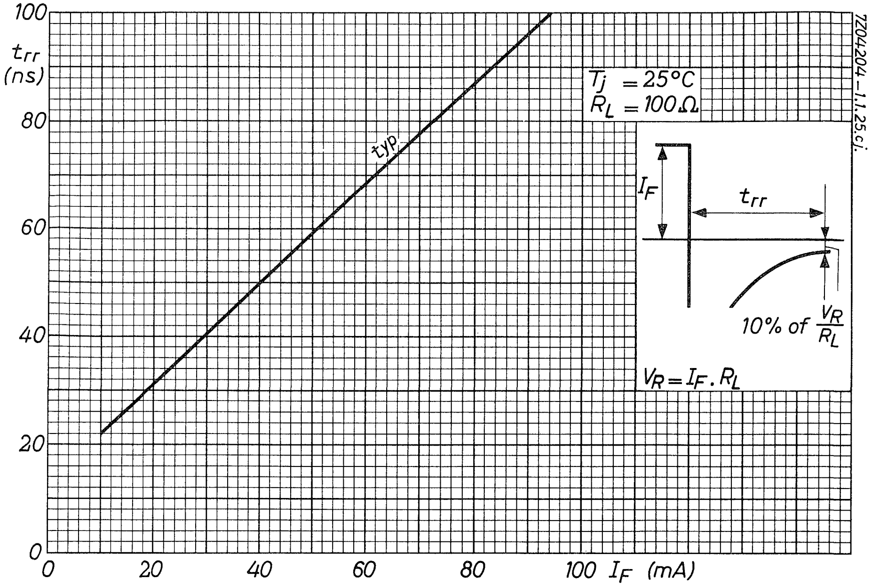

7Z04157
AAY30
max
max
$V_R = 50V$
10V
T_j (°C)
I_R (μA)

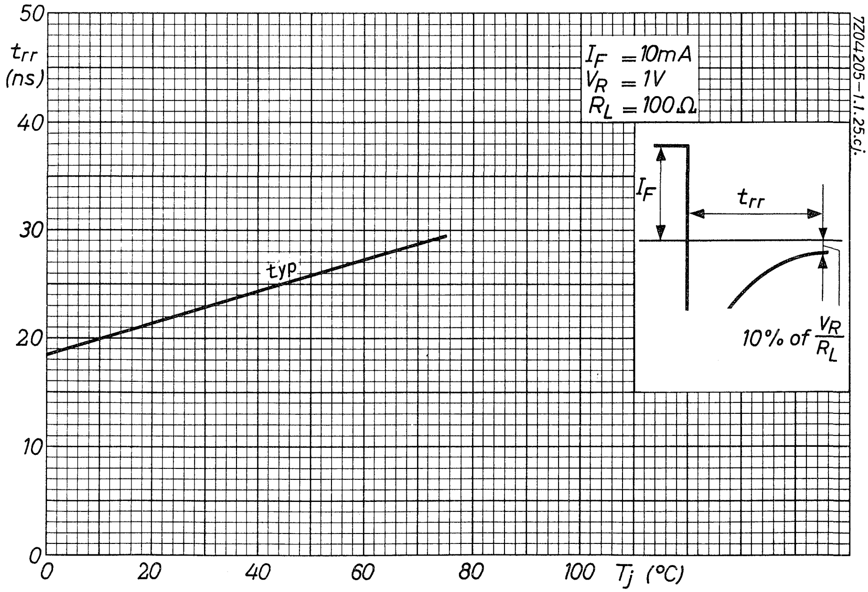

7Z04159
max. voltage
$T_j = 25°C$
I_F (mA)
10^3
2
10^2
5
2
10
5
2
1
5
2
10^{-1}
0
0.2
0.4
0.6
0.8
1
V_F (V)


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


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


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


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.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 = 100Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
7Z04205-1.1.25.cj.

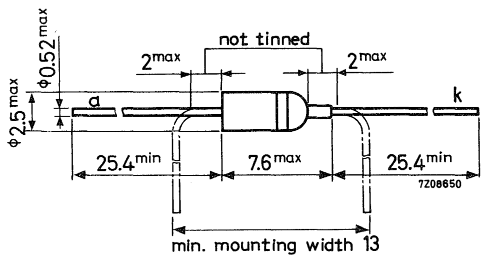
GOLD BONDED DIODE

Gold bonded germanium diode in subminiature all glass DO-7 envelope, intended for high speed switching applications.

MECHANICAL DATA

Dimensions in mm

DO 7



The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Voltage

Continuous reverse voltage	V_R	max.	8	V

Currents

Forward current (d.c. or average over any 50 ms period)	I_F	max.	30	mA
Repetitive peak forward current ($t < 5$ ms)	I_{FRM}	max.	100	mA

Temperatures

Storage temperature	T_{stg}	-55 to	+75	^oC
Junction temperature	T_j	max.	75	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.5	$^oC/mW$

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Forward voltage

I_F = 1 mA	V_F	typ.	0.27	V
		<	0.32	V
I_F = 10 mA	V_F	typ.	0.50	V
		<	0.60	V
I_F = 30 mA	V_F	typ.	0.60	V
		<	1.00	V

Reverse current

		T_{amb} =	25	60 °C	
V_R = 3 V	I_R	typ.	5	30	μA
		<	25	85	μA
V_R = 8 V	I_R	typ.	30	190	μA
		<	150		μA

Diode capacitance

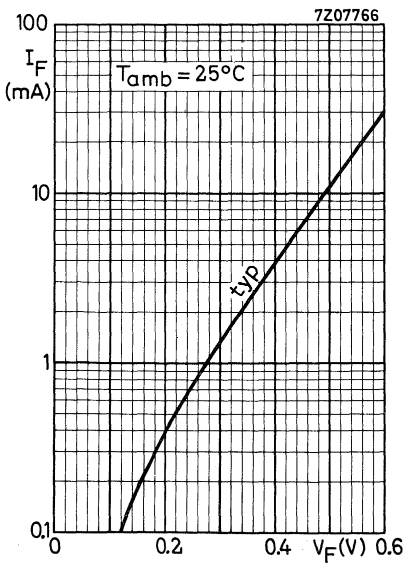
V_R = 1 V	C_d	typ.	3.3	pF
V_R = 3 V	C_d	typ.	1.3	pF
		<	2.0	pF

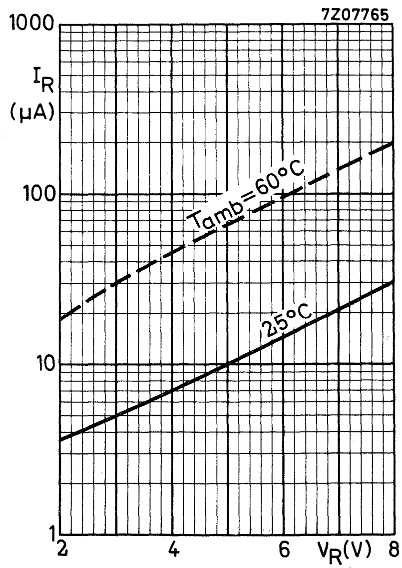
Forward recovery voltage

I_F = 20 mA; t_r = 5 ns	V_{FM}	typ.	0.7	V
		<	1.5	V

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 0.5 kΩ; t_f = 5 ns	Q_s	typ.	20	pC
		<	30	pC





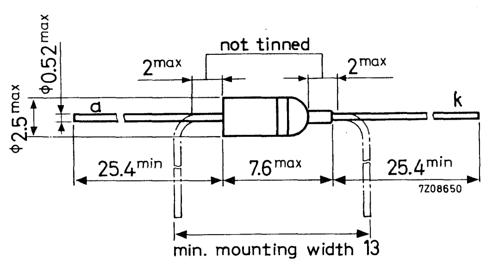
GOLD BONDED DIODES

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	^oC
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 coloured band indicates the cathode

RATINGS (Limiting values) [1])

Voltages

			AAZ15	AAZ17	
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	^oC
Junction temperature	T_j	max.	85	^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.

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

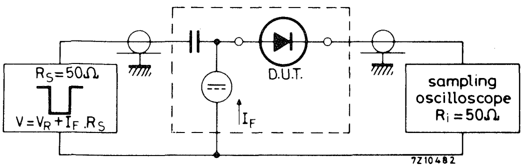
			AAZ15	AAZ17	
Reverse current at T_j = 25 °C					
V_R = 1.5 V	I_R	<	2.5	2.5	μA
V_R = 10 V	I_R	<	4	15	μA
V_R = 50 V	I_R	<	15	150	μA
V_R = 75 V	I_R	<	25	300	μA
V_R = 100 V	I_R	<	100	-	μA
Reverse current at T_j = 60 °C					
V_R = 1.5 V	I_R	<	30	30	μA
V_R = 10 V	I_R	<	40	60	μA
V_R = 50 V	I_R	<	80	300	μA
V_R = 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

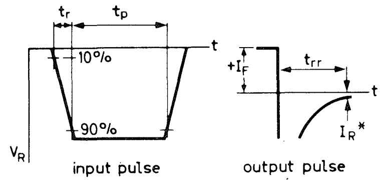
CHARACTERISTICS (continued) $T_j = 25\ ^oC$

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 $\frac{V_R}{R_L}$	AAZ15	t_{rr}	typ.	350	ns
	AAZ17	t_{rr}	<	350	ns

Test circuit:





*) $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

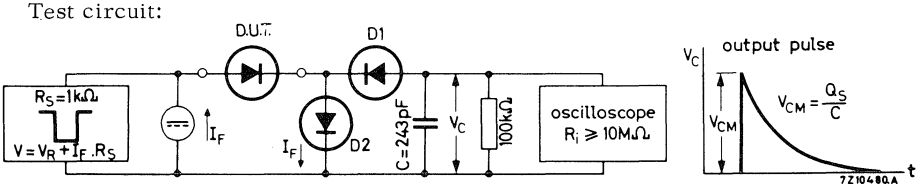
Reverse pulse:	Rise time	t_r	= 0.6	ns
	Pulse duration	t_p	= 100	ns
	Duty cycle	δ	= 0.05	

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

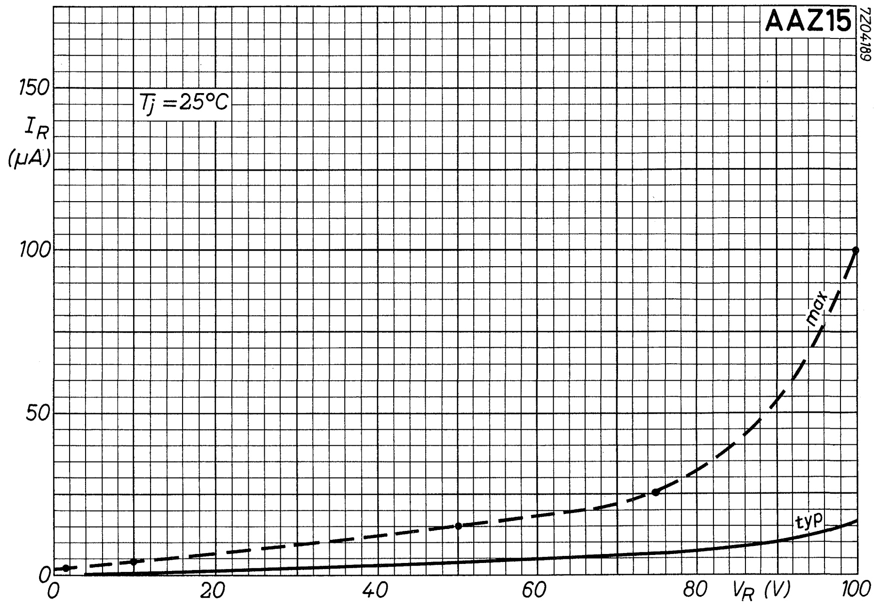
AAZ15	Q_s	<	1800	pC
AAZ17	Q_s	<	900	pC

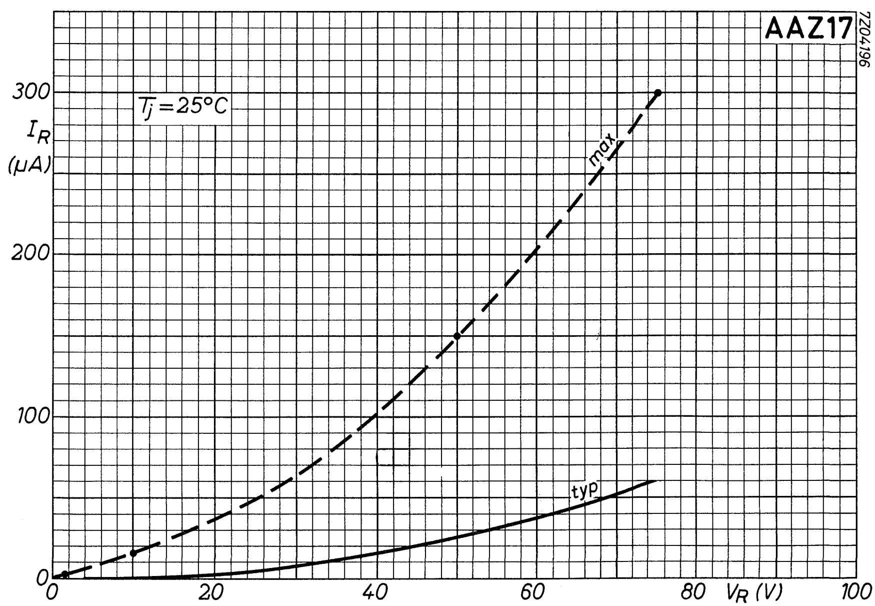
Test circuit:

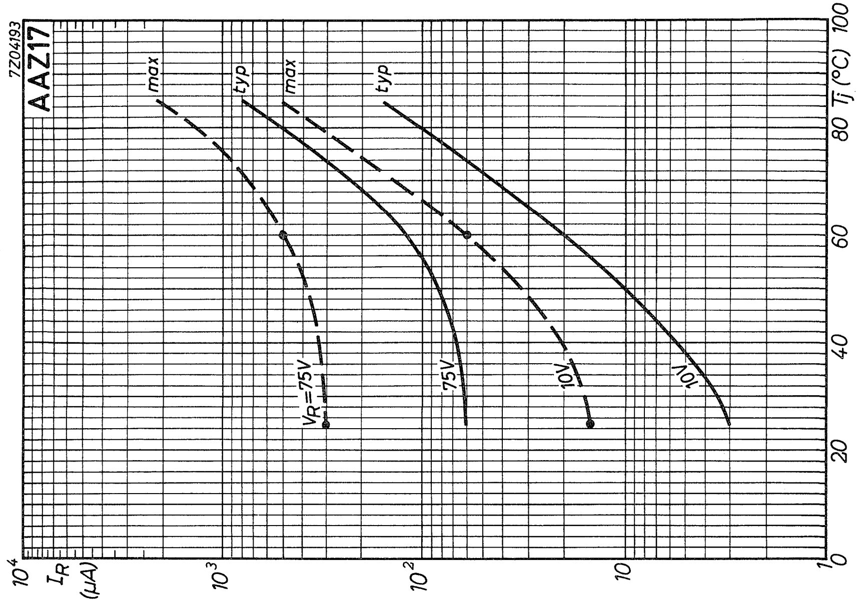


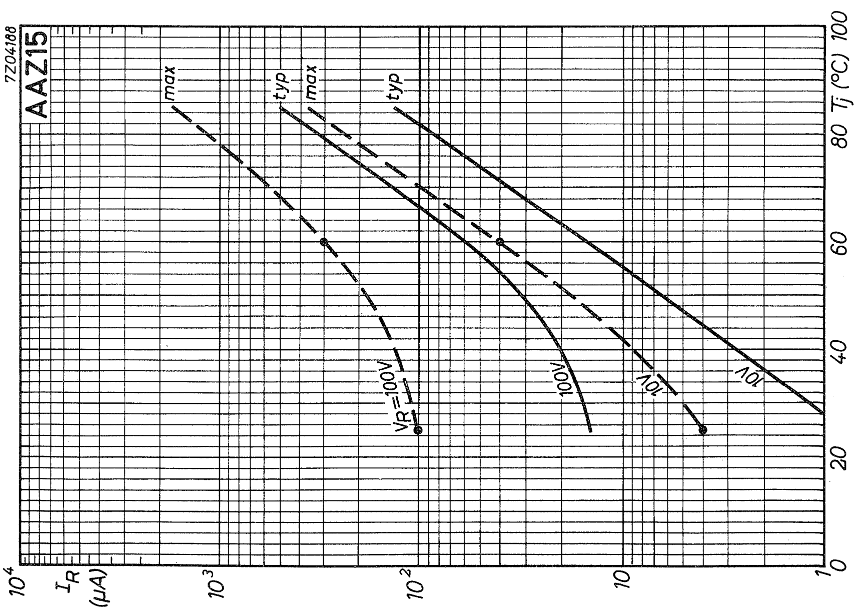
D1 = D2 = BAW62

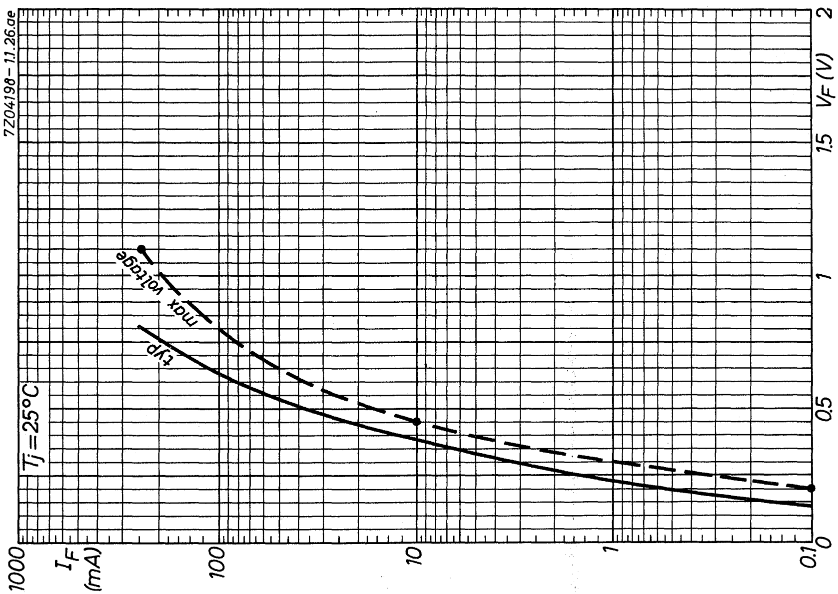
Reverse pulse:	Rise time	t_r	= 2	ns
	Pulse duration	t_p	= 0.4	µs
	Duty cycle	δ	= 0.02	

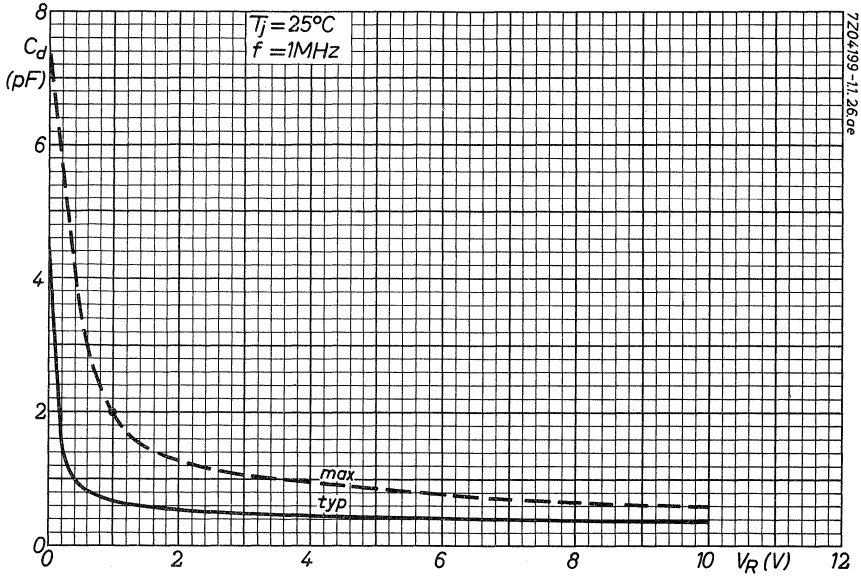

AAZ15
7Z04189
T_j = 25°C
I_R (μA)
150
100
50
0
max
typ
0
20
40
60
80
V_R (V)
100

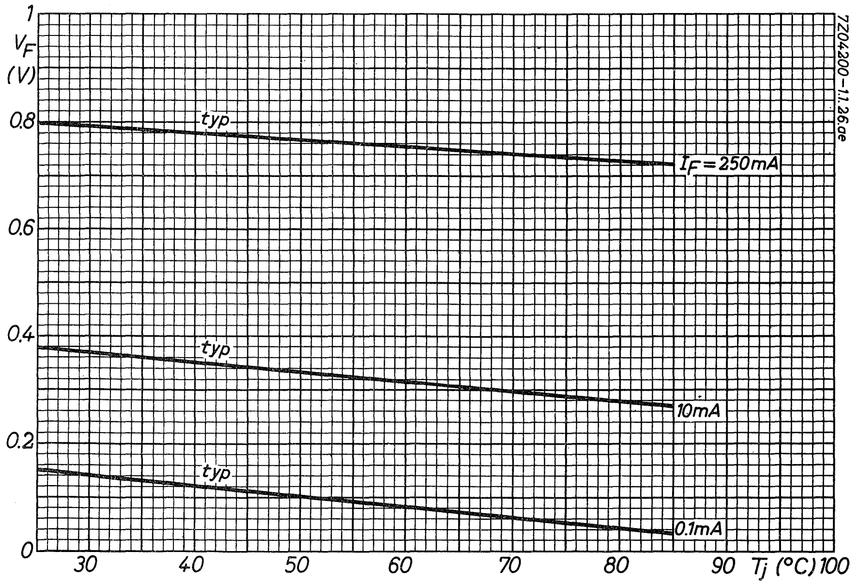

AAZ17
7Z04196
T_j = 25°C
I_R (μA)
300
200
100
0
max
typ
0
20
40
60
80
V_R (V)
100

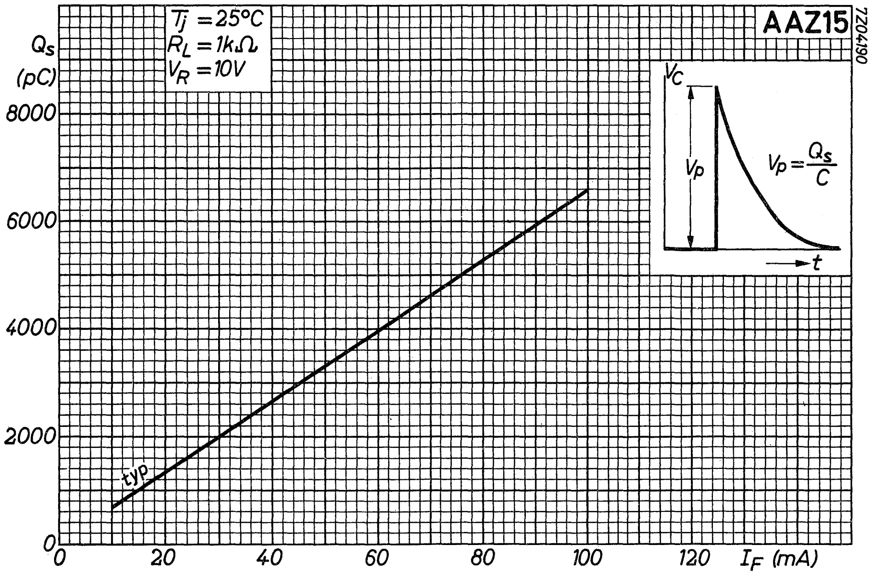

7Z04193
AAZ17
max
typ
max
typ
VR=75V
75V
10V
10V
I_R (μA)
Tj (°C)

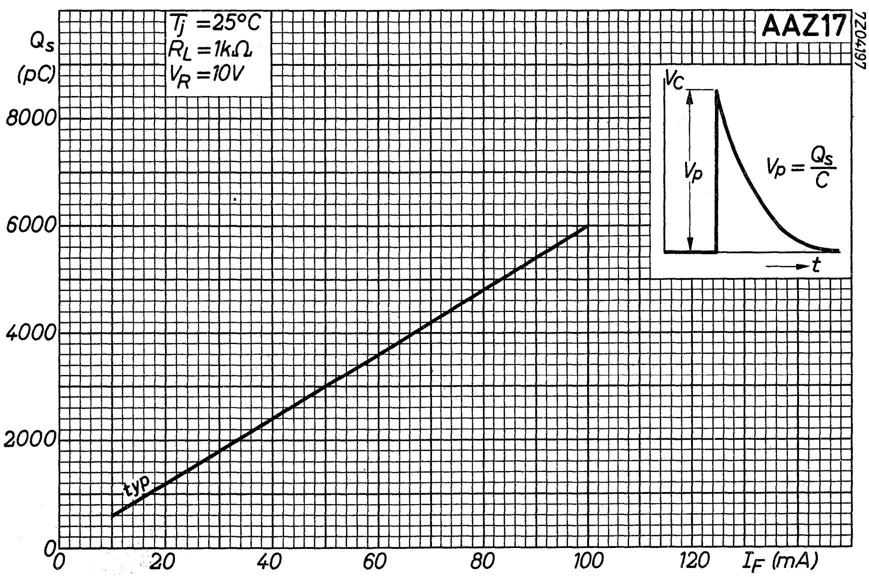

7Z04188
AAZ15
max
typ
max
typ
VR=100V
100V
10V
10V
I_R (μA)
Tj (°C)

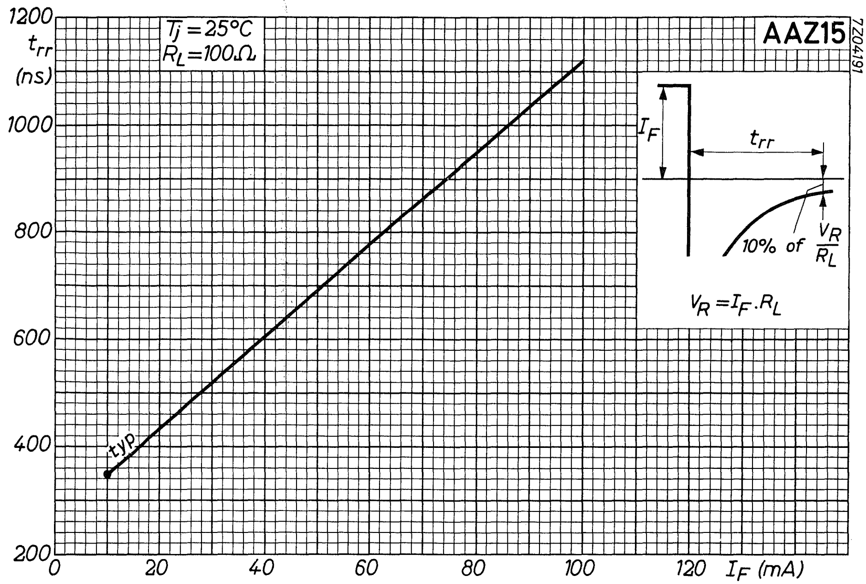

7Z04198 - 1.1.26.ae
$T_j = 25°C$
max voltage
typ
1000
I_F (mA)
100
10
1
0.1
0
0.5
1
1.5
2
V_F (V)

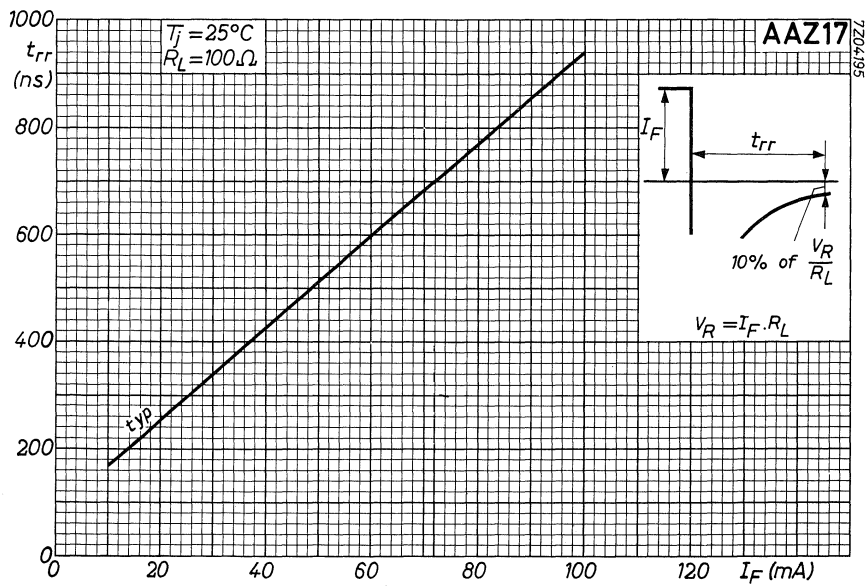

$T_j = 25°C$
$f = 1MHz$
C_d
(pF)
8
6
4
2
0
max
typ
0
2
4
6
8
10
V_R (V)
12
7Z04199-1.1.26ae

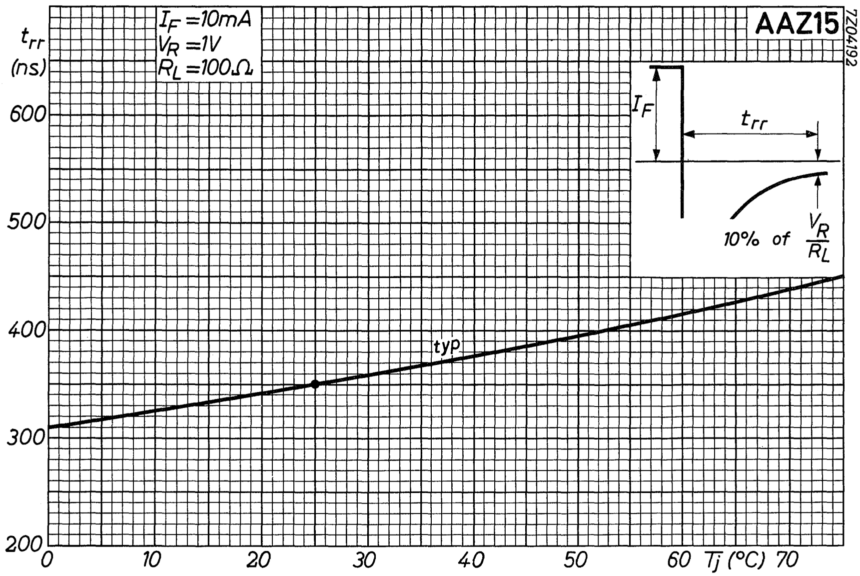

1
V_F
(V)
0.8
0.6
0.4
0.2
0
typ
I_F = 250mA
typ
10mA
typ
0.1mA
30
40
50
60
70
80
90
T_j (°C)
100
7Z04200-1.1.26ae

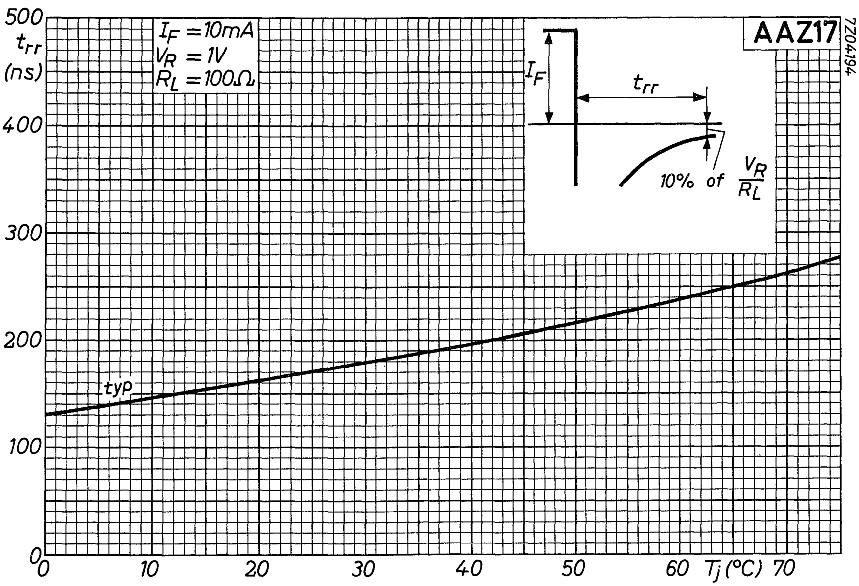

7Z04190
AAZ15
T_j = 25°C
R_L = 1kΩ
V_R = 10V
Q_s
(pC)
8000
6000
4000
2000
0
typ
0
20
40
60
80
100
120
I_F (mA)
V_C
V_p
$V_p = \frac{Q_s}{C}$
t


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


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


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

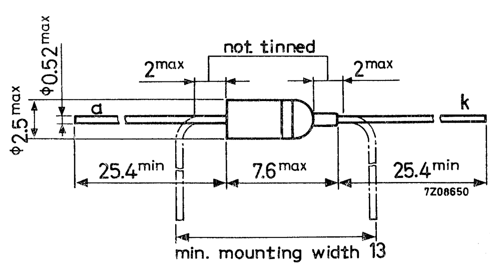
GOLD BONDED DIODE

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	^oC
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 coloured band indicates the cathode

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.

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 [1]	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 [1]	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

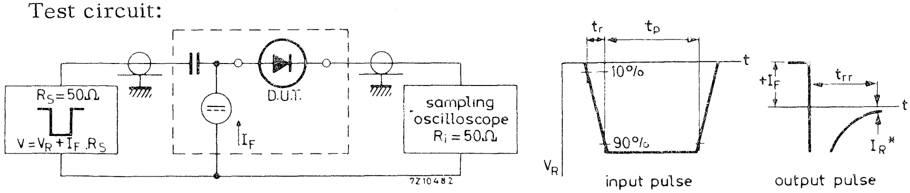
[1]) Measured under pulsed conditions to prevent excessive dissipation.

CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$

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

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

Test circuit:



*) $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

Reverse pulse: Rise time t_r = 0.6 ns

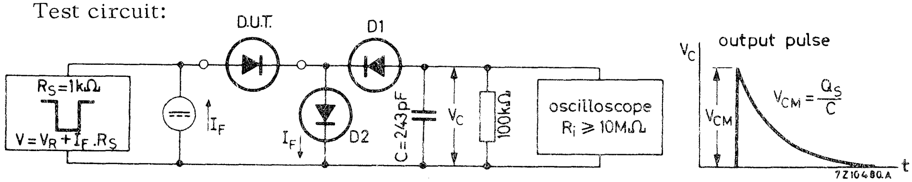
Pulse duration t_p = 100 ns

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:



D1 = D2 = BAW62

Reverse pulse: Rise time t_r = 2 ns

Pulse duration t_p = 0.4 μs

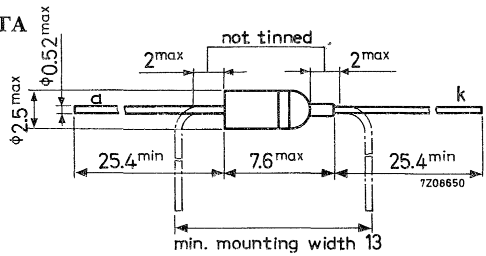
Duty cycle δ = 0.02

SILICON DIODE

General purpose silicon diode in a subminiature all glass DO-7 envelope.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Voltage

Continuous reverse voltage	V_R	max.	60	V

Currents

Forward current (d.c.)	I_F	max.	90	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Non repetitive peak forward current ($t \leq 1$ s)	I_{FSM}	max.	200	mA

Temperatures

Storage temperature	T_{stg}	-55 to +90		°C
Junction temperature	T_j	max.	90	°C

THERMAL RESISTANCE

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

CHARACTERISTICS

Forward voltage

		T_{amb} = 25 °C	T_{amb} = 60 °C	
I_F = 0.1 mA	V_F	typ. 0.55	typ. 0.5	V
		< 0.75		V
I_F = 1.0 mA	V_F	typ. 0.65	typ. 0.6	V
		0.5 to 1.0	0.4 to 0.9	V
I_F = 30 mA	V_F	typ. 0.9	typ. 0.85	V
		< 1.5	< 1.5	V

Reverse current

		T_{amb} = 60 °C	T_{amb} = 75 °C	
V_R = 10 V	I_R	typ. 5.0	< 10	μA
V_R = 60 V	I_R	typ. 10	< 20	μA

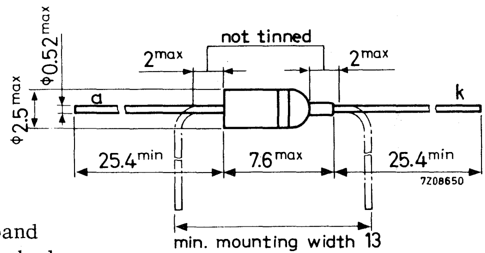
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

SILICON ALLOYED JUNCTION DIODE

Silicon alloyed junction diode in subminiature all-glass DO-7 envelope intended for use as low voltage stabilizer.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Current

Forward current (d.c.)	I_F	max.	20	mA

Temperatures

Storage temperature	T_{stg}	-55 to +90	^oC
Operating ambient temperature	T_{amb}	-55 to +90	^oC

THERMAL RESISTANCE

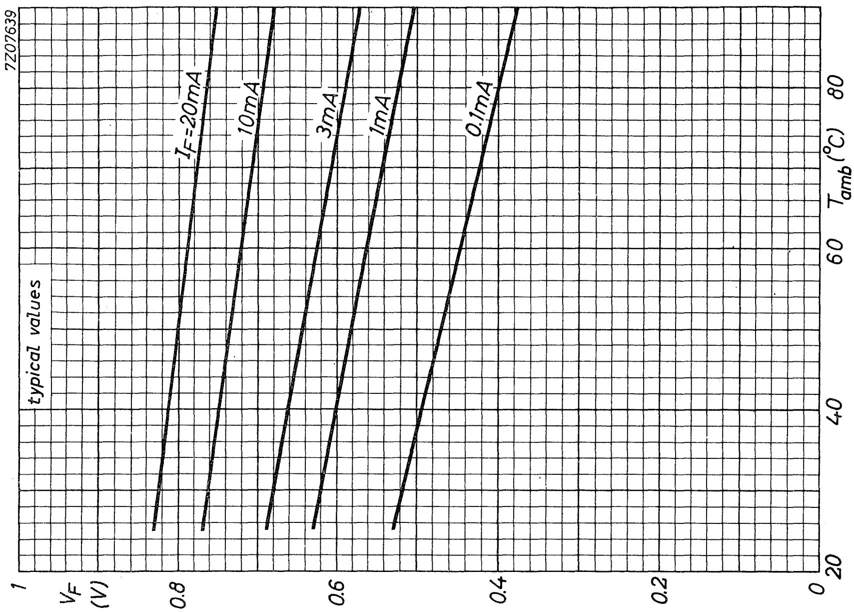
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	$^oC/mW$

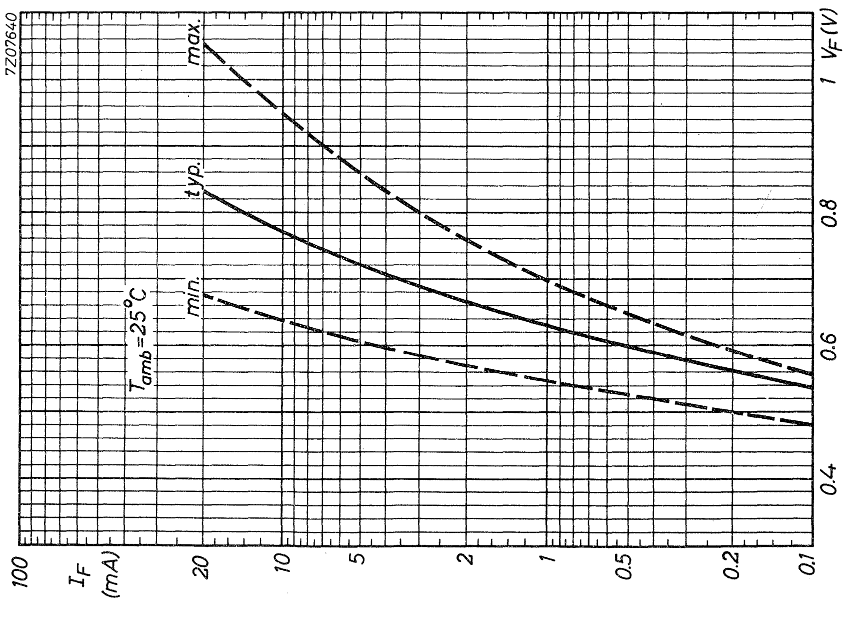
CHARACTERISTICS T_{amb} = 25 ^oC

Forward voltage

I_F = 0.2 mA	V_F	>	0.5	V
I_F = 3 mA	V_F	<	0.8	V

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


7Z07639
typical values
I_F=20mA
10mA
3mA
1mA
0.1mA
T_{amb} (°C)
20
40
60
80
V_F (V)
1
0.8
0.6
0.4
0.2
0


7Z07640
max.
typ.
min.
T_{amb}=25°C
V_F (V)
1
0.8
0.6
0.4
I_F (mA)
100
20
10
5
2
1
0.5
0.2
0.1

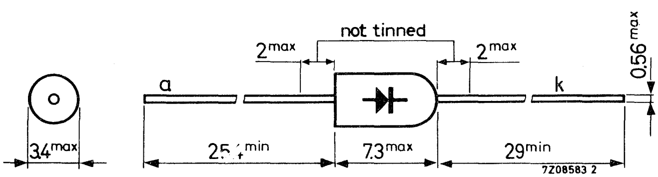
HIGH SPEED SILICON DIODE

Double diffused diode in a DO-14 plastic envelope primarily intended for use in clamp circuits of colour difference amplifiers in television receivers.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	300	V
Average forward current	I_{FAV}	max.	0.3	A
Non repetitive peak forward current half sine wave; t = 10 ms	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	125	^oC
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.2	$^oC/mW$
Recovered charge when switched from I_F = 10 mA to V_R = 2 V with $-\frac{dI}{dt}$ = 5 mA/μs; T_j = 25 ^oC	Q_s	<	0.4	nC

MECHANICAL DATA Dimensions in mm

DO-14



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

RATINGS (Limiting values) [1])

Voltages

Crest working reverse voltage	V_{RWM}	max.	300	V
Repetitive peak reverse voltage	V_{RRM}	max.	350	V
Non repetitive peak reverse voltage ($t < 1$ ms)	V_{RSM}	max.	350	V

Currents

Forward current (d.c.)	I_F	max.	0.3	A
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	0.3	A
Repetitive peak forward current	I_{FRM}	max.	2	A
Non repetitive peak forward current half sine wave; t = 10 ms	I_{FSM}	max.	15	A
Repetitive peak reverse current	I_{RRM}	max.	0.5	A

Temperatures

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

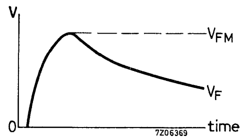
THERMAL RESISTANCE

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

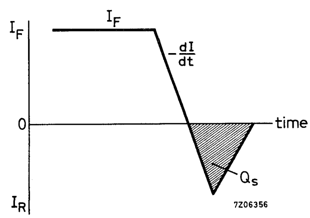
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

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

Forward voltage at $I_F = 100$ mA; $T_j = 75\ ^oC$	V_F	<	1.0	V
Reverse current at $V_R = 300$ V; $T_j = 75\ ^oC$	I_R	<	10	μA
Diode capacitance at f = 1 MHz				
$V_R = 150$ V; $T_j = 25\ ^oC$ to $125\ ^oC$	C_d	typ.	4.0	pF
Switching characteristics				
Forward recovery voltage				
$I_F = 100$ mA; $t_r = 50$ ns	V_{FM}	<	3.0	V



Recovered charge when switched from				
$I_F = 10$ mA to $V_R = 2$ V with				
$-\frac{dI}{dt} = 5$ mA/μs	Q_s	<	0.4	nC

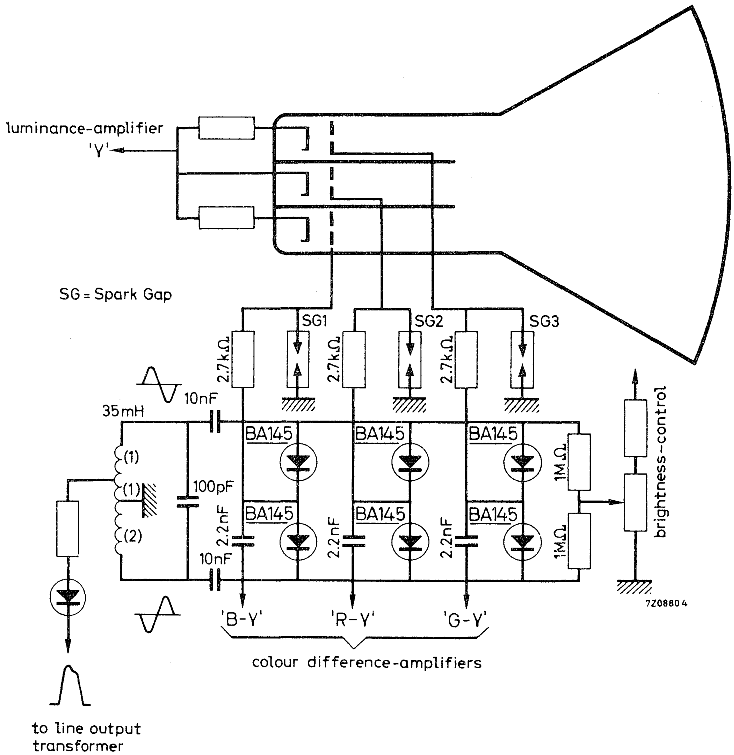


SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 ^oC; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125 ^oC.

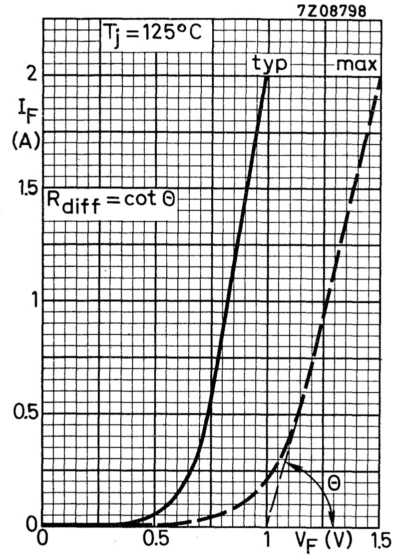
APPLICATION INFORMATION

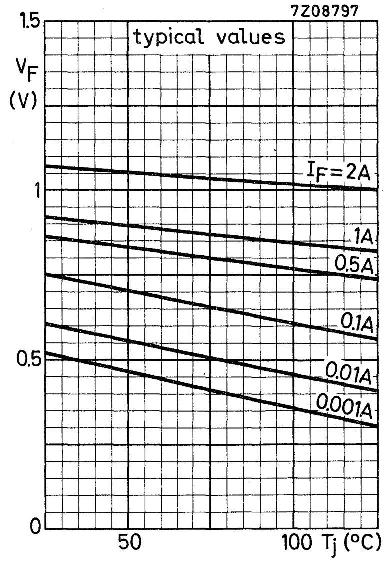
Clamp circuit for colour difference amplifiers in television receivers.

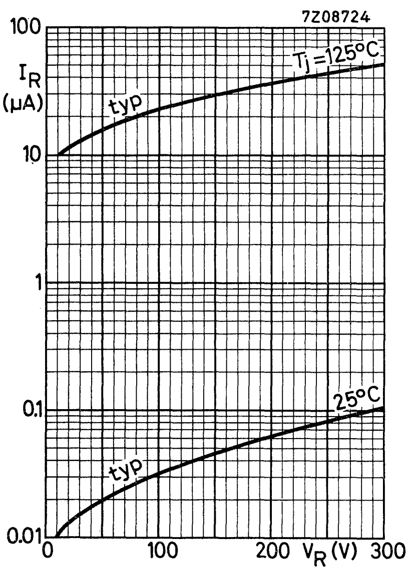


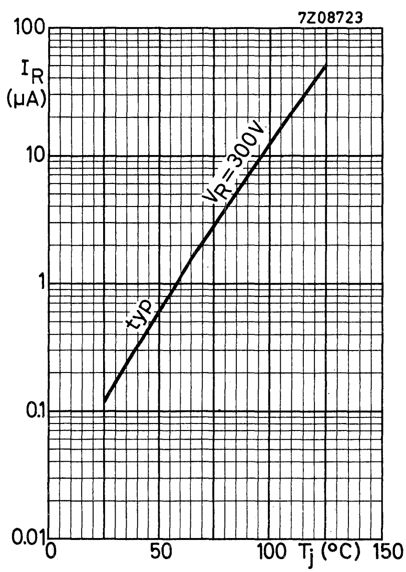
Up to T_{amb} = 65°C the differences in clamping levels in the circuit will be less than 1 V.

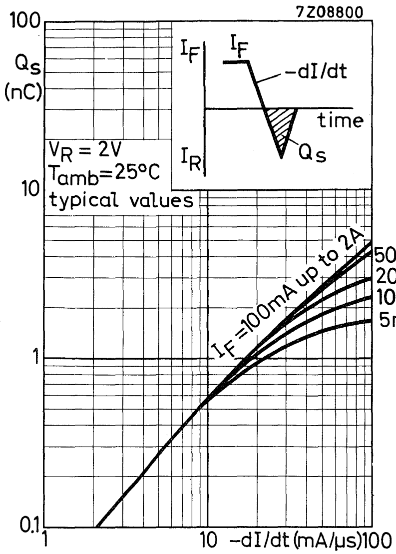
When in a picture tube flash-over occurs, it is possible that high voltage peaks appear at the control grid. These voltage peaks can damage the diodes in the clamp circuit. Protection of the diodes is obtained by means of a spark gap with breakover voltage of < 3000 V and a resistor of 2.7 kΩ.

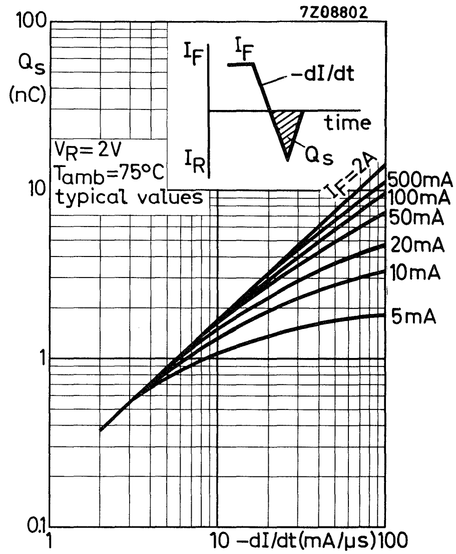

7Z08798
$T_j = 125°C$
typ
max
I_F (A)
$R_{diff} = \cot \Theta$
Θ
V_F (V)
0
0.5
1
1.5
2

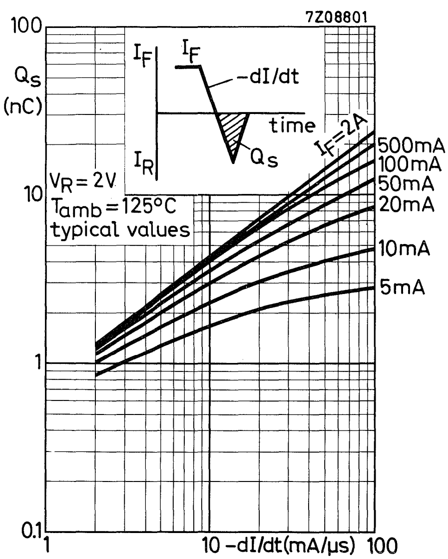

7Z08797
typical values
V_F (V)
$I_F = 2A$
1A
0.5A
0.1A
0.01A
0.001A
0
0.5
1
1.5
50
100 T_j (°C)

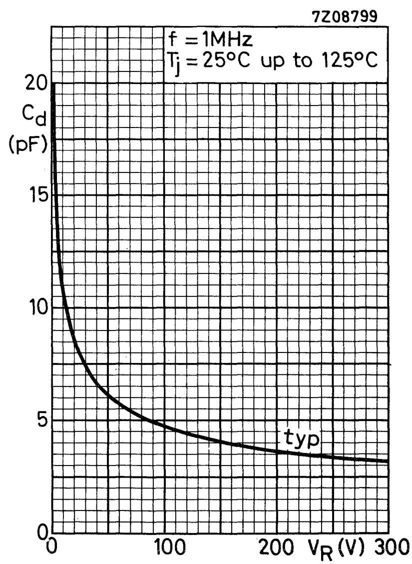

7Z08724
I_R (µA)
$T_j = 125°C$
typ
25°C
typ
100
10
1
0.1
0.01
0
100
200 V_R (V) 300


7Z08723
I_R (µA)
$V_R = 300V$
typ
100
10
1
0.1
0.01
0
50
100 T_j (°C) 150


7Z08800
100
Q_s
(nC)
10
1
0.1
1
10 $-dI/dt$ (mA/μs) 100
I_F
I_R
$-dI/dt$
time
Q_s
$V_R = 2V$
$T_{amb} = 25°C$
typical values
I_F = 100mA up to 2A
50mA
20mA
10mA
5mA


7Z08802
100
Q_s
(nC)
10
1
0.1
1
10 $-dI/dt$ (mA/μs) 100
I_F
I_R
$-dI/dt$
time
Q_s
$V_R = 2V$
$T_{amb} = 75°C$
typical values
$I_F = 2A$
500mA
100mA
50mA
20mA
10mA
5mA


7Z08801
100
Q_s
(nC)
10
1
0.1
1
10 $-dI/dt$ (mA/μs) 100
I_F
I_R
$-dI/dt$
time
Q_s
$V_R = 2V$
$T_{amb} = 125°C$
typical values
$I_F = 2A$
500mA
100mA
50mA
20mA
10mA
5mA


7Z08799
f = 1MHz
T_j = 25°C up to 125°C
20
C_d
(pF)
15
10
5
0
0
100
200 V_R (V) 300
typ

FAST RECOVERY SILICON DIODE

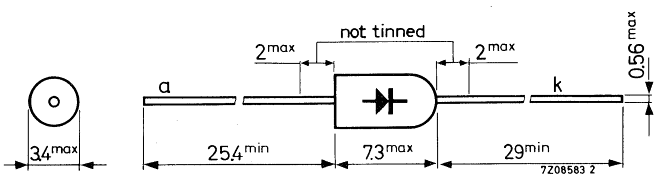
Double diffused general purpose diode in a DO-14 plastic envelope for use as line phase detector, scan rectifier for the supply of the small signal parts in television receivers and other h.f. power supplies.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	300	V
Average forward current; V_{RWM} = 300 V	I_{FAV}	max.	0.4	A
V_{RWM} = 80 V	I_{FAV}	max.	0.5	A
Non-repetitive peak forward current half sine wave; t = 10 ms; T_j = 125 °C prior to surge	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	150	°C
Reverse recovery charge when switched from I_F = 10 mA to V_R = 2 V with $-\frac{dI}{dt}$ = 5 mA/µs; T_j = 25 °C	Q_s	<	0.8	nC

MECHANICAL DATA

Dimensions in mm

DO-14



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

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

Voltages

Crest working reverse voltage	V_{RWM}	max.	300 V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	350 V
Non-repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	350 V

Currents

→ Average forward current (averaged over any 20 ms period) $V_{RWM} = 300$ V	I_{FAV}	max.	0.4 A
$V_{RWM} = 80$ V	I_{FAV}	max.	0.5 A
→ Repetitive peak forward current	I_{FRM}	max.	3.0 A
Non-repetitive peak forward current half sine wave; $t = 10$ ms; $T_j = 125$ °C prior to surge	I_{FSM}	max.	15 A
Repetitive peak reverse current	I_{RRM}	max.	0.5 A

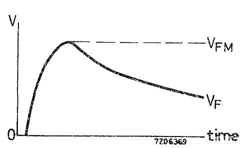
Temperatures

Storage temperature	T_{stg}		−65 to +125 °C
→ Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE See page 3

CHARACTERISTICS

Forward voltage at $I_F = 2$ A; $T_j = 150$ °C	V_F	<	1.5 V[1]
Peak reverse current at V_{RM}=300 V; $T_j = 125$ °C	I_{RM}	<	200 µA
Diode capacitance at f = 1 MHz $V_R = 150$ V; $T_j = 25$ to 125 °C	C_d	typ.	4.0 pF
Switching characteristics at $T_j = 25$ °C; Forward recovery voltage $I_F = 100$ mA; $t_r = 50$ ns	V_{FM}	<	3.0 V



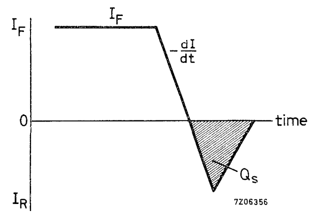
[1]) Measured under pulsed conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Reverse recovery charge when switched from.

I_F = 10 mA to V_R = 2 V with

$-\frac{dI}{dt}$ = 5 mA/µs; T_j = 25 °C $\qquad$ Q_s < 0.8 nC

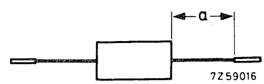


THERMAL RESISTANCE

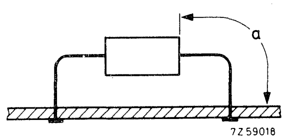
Effect of mounting on thermal resistance $R_{th\ j-a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 150 °C/W

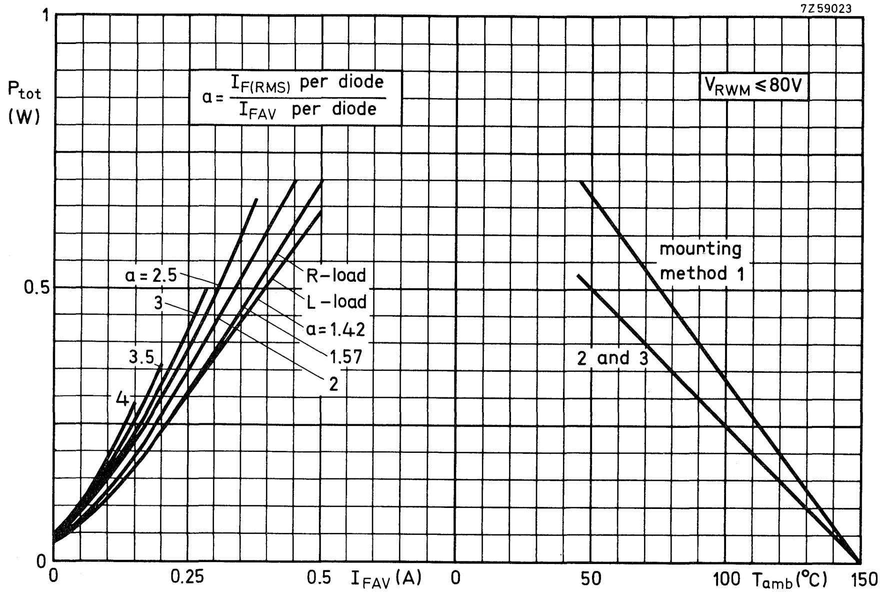


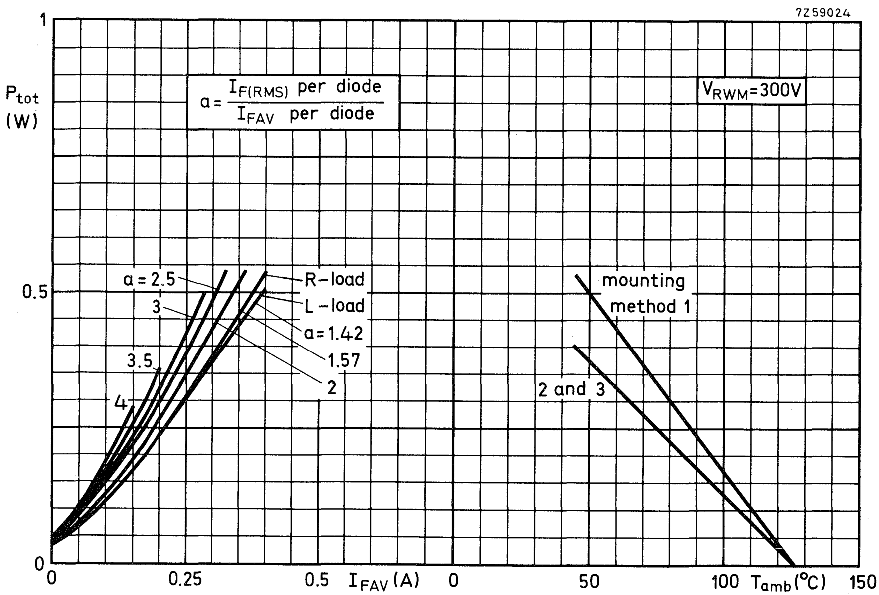
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 200 °C/W
3. Mounted on printed-wiring board with a small area of copper at a lead-length a > 5 mm. $R_{th\ j-a}$ = 200 °C/W



SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125°C.


7Z59023
P_{tot} (W)
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
$V_{RWM} \leq 80V$
a = 2.5
3
3.5
4
R-load
L-load
a = 1.42
1.57
2
mounting method 1
2 and 3
I_{FAV} (A)
T_{amb} (°C)

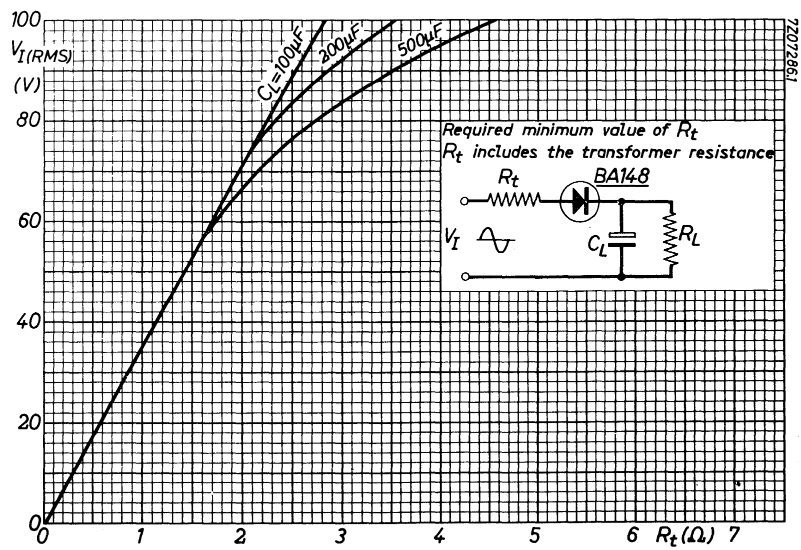

7Z59024
P_{tot} (W)
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
$V_{RWM} = 300V$
a = 2.5
3
3.5
4
R-load
L-load
a = 1.42
1.57
2
mounting method 1
2 and 3
I_{FAV} (A)
T_{amb} (°C)

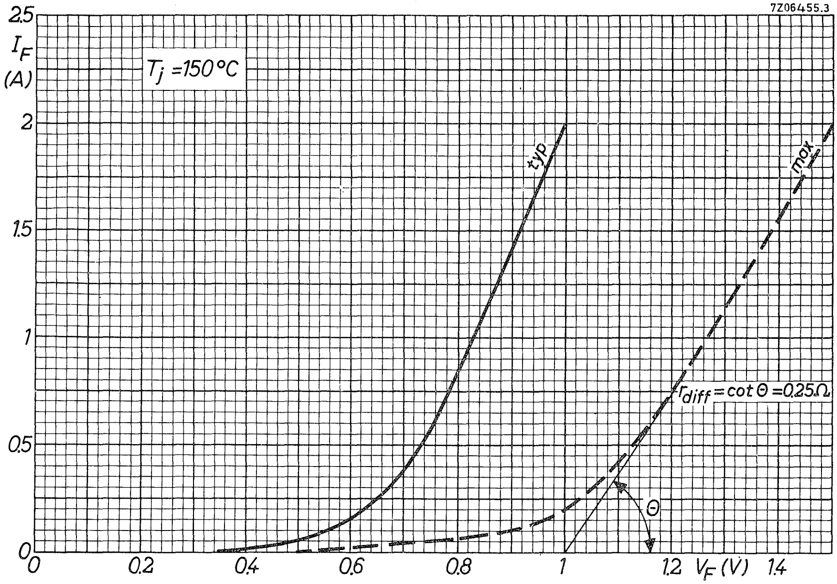
From the left hand graph the total power dissipation can be found as a function of the forward current.

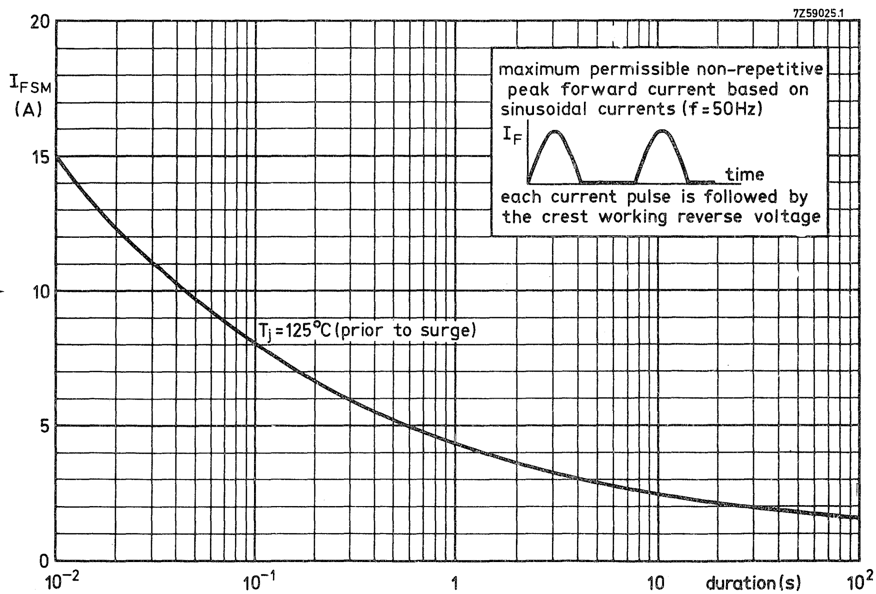
The parameter $a = \dfrac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\dfrac{R_t + r_{diff.}}{R_L}$ and can be found from existing graphs.

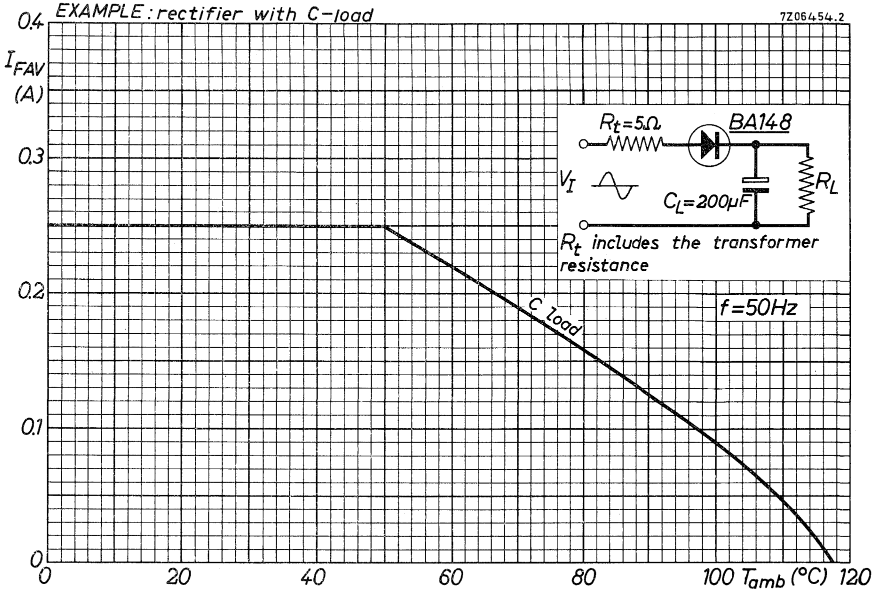
See Application Book: RECTIFIER DIODES
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

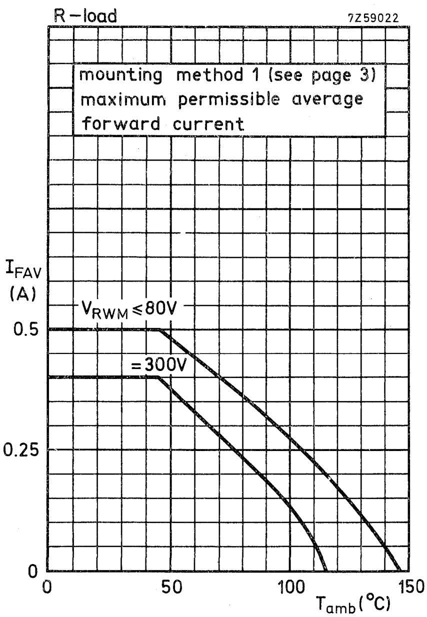
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the graph below.
rdiff. is shown on page 6, upper figure.

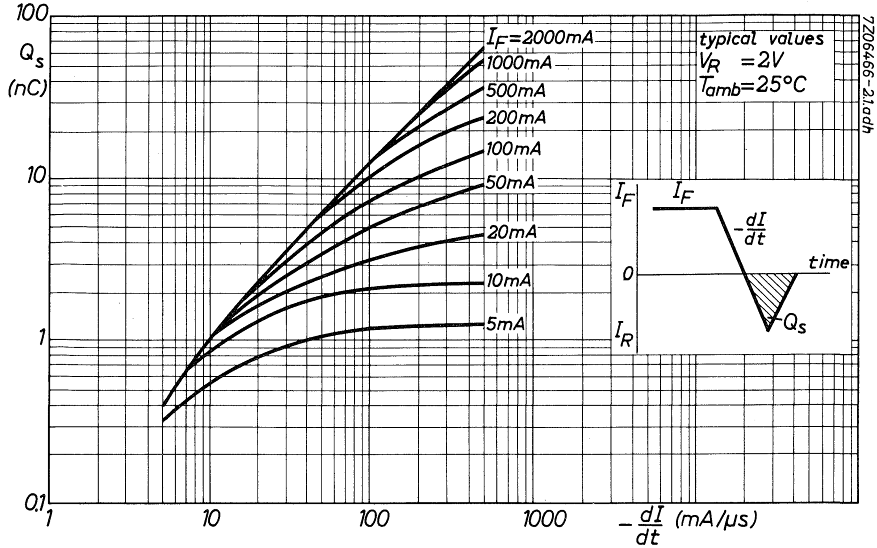


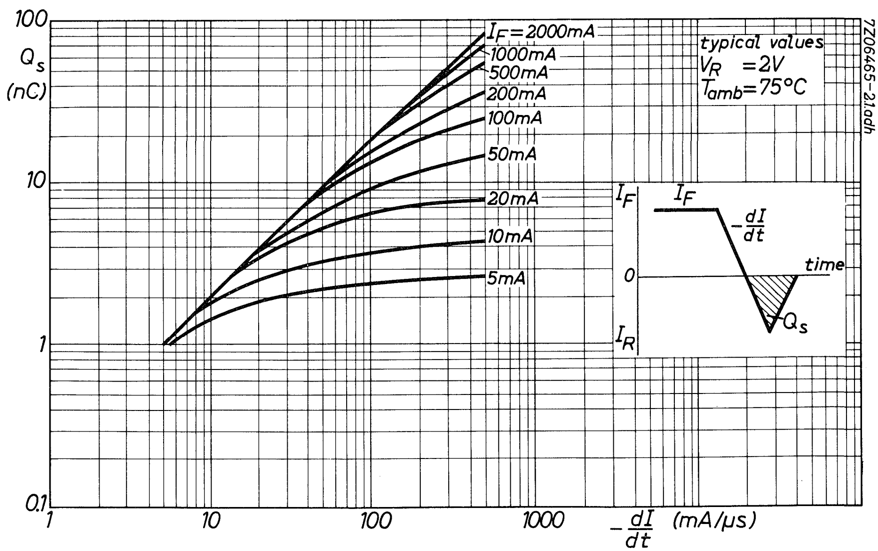

7Z06455.3
I_F (A)
T_j = 150 °C
typ
max
$r_{diff} = \cot \Theta = 0.25 \Omega$
Θ
V_F (V)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0.5
1.5
2
2.5

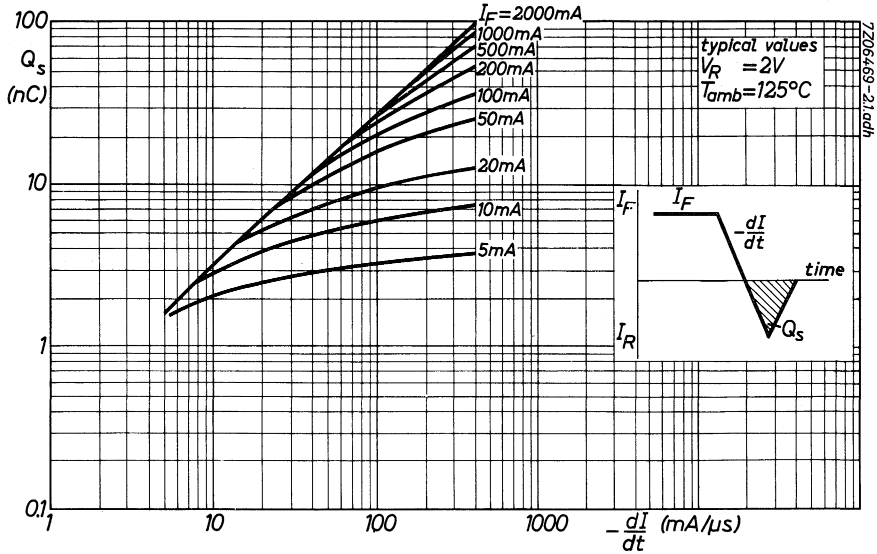

7Z59025.1
I_{FSM} (A)
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 125 °C (prior to surge)
duration (s)
10^{-2}
10^{-1}
1
10
10^2
0
5
10
15
20

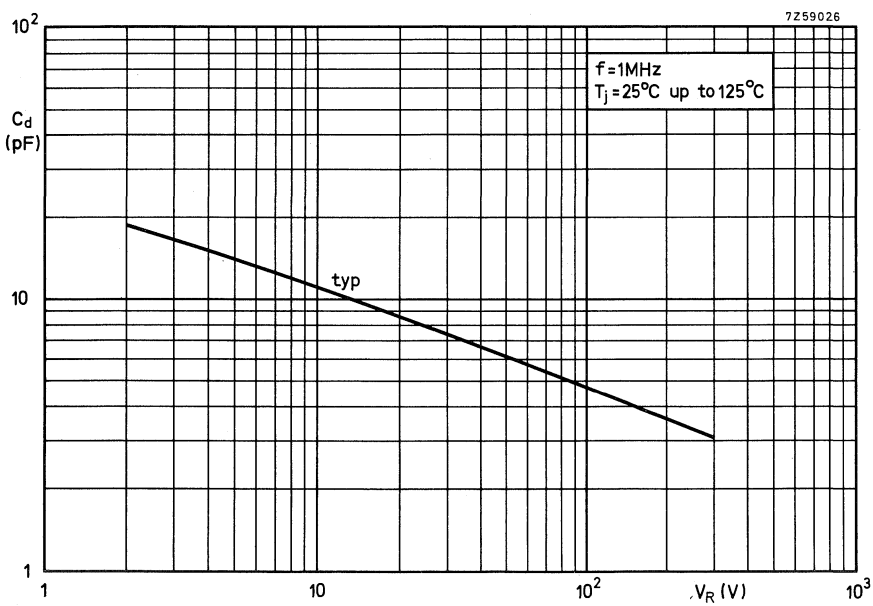

EXAMPLE: rectifier with C-load
7Z06454.2
I_{FAV} (A)
0.4
0.3
0.2
0.1
0
R_t=5Ω
BA148
V_I
C_L=200μF
R_L
R_t includes the transformer resistance
C load
f=50Hz
0
20
40
60
80
100
120
T_{amb} (°C)


R-load
7Z59022
mounting method 1 (see page 3)
maximum permissible average
forward current
I_{FAV} (A)
V_{RWM} ≤ 80V
= 300V
0.5
0.25
0
0
50
100
150
T_{amb} (°C)


100
Q_s
(nC)
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=25°C
7Z06466-2.1.adh
I_F
I_F
$-\frac{dI}{dt}$
0
time
Q_s
I_R

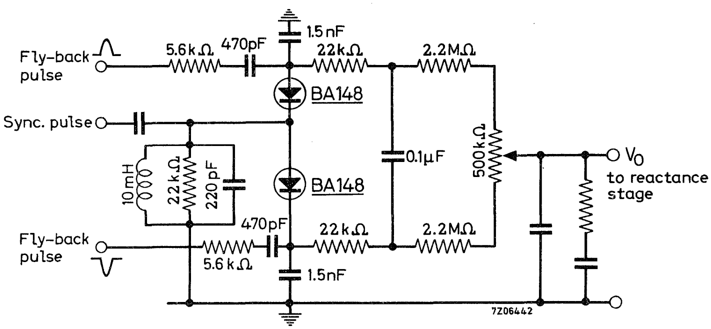

100
Q_s
(nC)
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=75°C
7Z06465-2.1.adh
I_F
I_F
$-\frac{dI}{dt}$
0
time
Q_s
I_R


100
Q_s
(nC)
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R = 2V
T_{amb}=125°C
7Z06469-2.1.adh
I_F
I_R
$-\frac{dI}{dt}$
time
Q_s


7Z59026
10^2
C_d
(pF)
10
1
1
10
10^2
V_R (V)
10^3
f = 1MHz
T_j = 25°C up to 125°C
typ

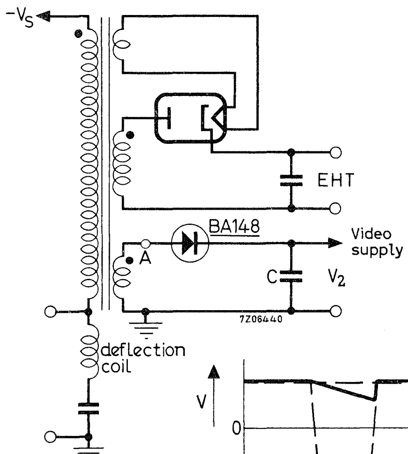
APPLICATION INFORMATION

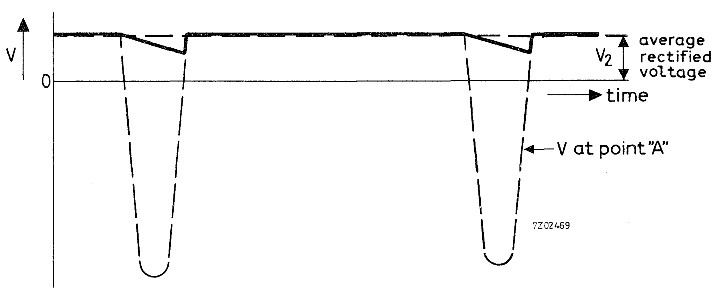
Self catching line phase detector



The high speed and low leakage current of the BA148 make it particularly useful in the type of line phase detector shown above.

Low voltage supply from the line output stage of a television receiver.





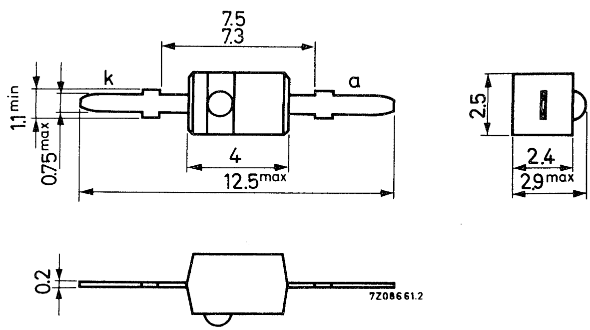
An extra winding on the line output transformer in series with a BA148 can supply up to 30 V for the low voltage parts of a television receiver. Because the diode conducts during scan the source impedance is low and the output voltage stable.

SILICON PLANAR DIODE

The BA182 is a switching diode in a plastic envelope. It is intended for band switching in v.h.f. television tuners.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	35	V
Forward current (d.c.)	I_F	max.	100	mA
Junction temperature	T_j	max.	100	^oC
Diode capacitance at f = 1 MHz V_R = 20 V	C_d	typ. <	0.8 1	pF pF
Series resistance at f = 200 MHz I_F = 5 mA	r_D	typ. <	0.5 0.7	Ω Ω

MECHANICAL DATA Dimensions in mm



The white band indicates the cathode

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

RATINGS (Limiting values) [1])

Voltage

Continuous reverse voltage	V_R	max.	35	V

Current

Forward current (d.c.)	I_F	max.	100	mA

Temperatures

Storage temperature	T_{stg}		−55 to +100	°C
Junction temperature	T_j	max.	100	°C

THERMAL RESISTANCE

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

CHARACTERISTICS

Forward voltage at I_F = 100 mA	V_F	<	1.2	V
Reverse current				
V_R = 20 V	I_R	<	100	nA
V_R = 20 V; T_j = 60 °C	I_R	<	1	µA
Diode capacitance at f = 1 MHz				
V_R = 20 V	C_d	typ.	0.8	pF
		<	1	pF
Series resistance at f = 200 MHz				
I_F = 5 mA	r_D	typ.	0.5	Ω
		<	0.7	Ω

MOUNTING AND SOLDERING INSTRUCTIONS

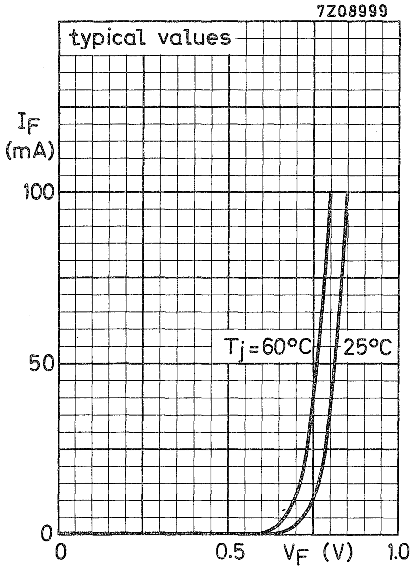
Mounting

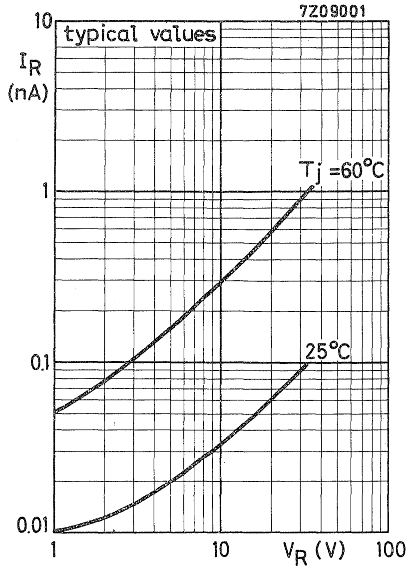
The leads must be bent with a radius of not less than 0.5 mm near the seal. (This can be done by hand if care is taken to exert no pulling force).

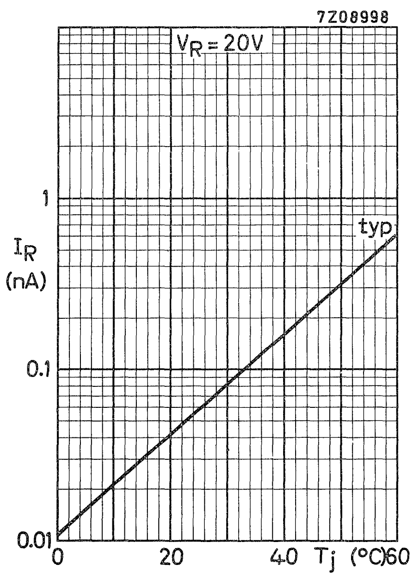
Soldering

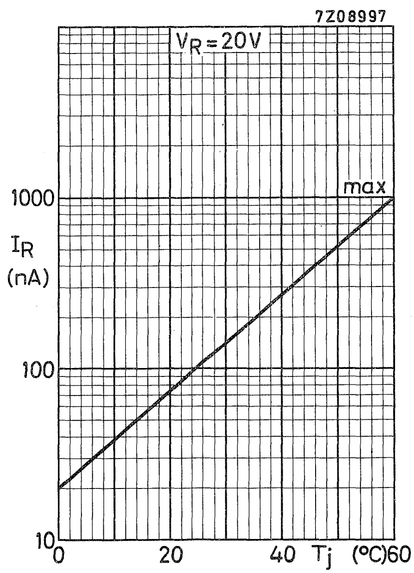
At a maximum iron or solder temperature of 300 °C, the maximum permissible soldering time is 3 seconds. The soldering spot may be at any distance from the seal. During soldering, care must be taken that the plastic body does not come into contact with any temperature higher than 125 °C.

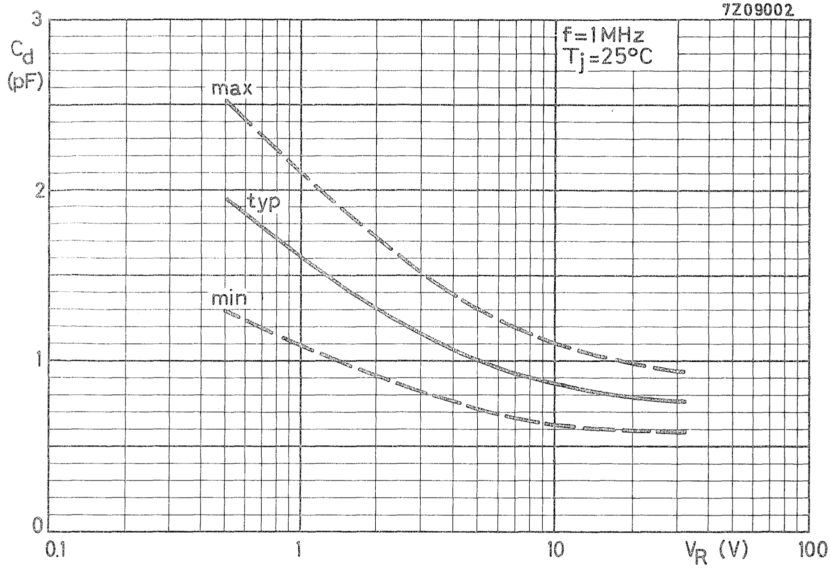
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

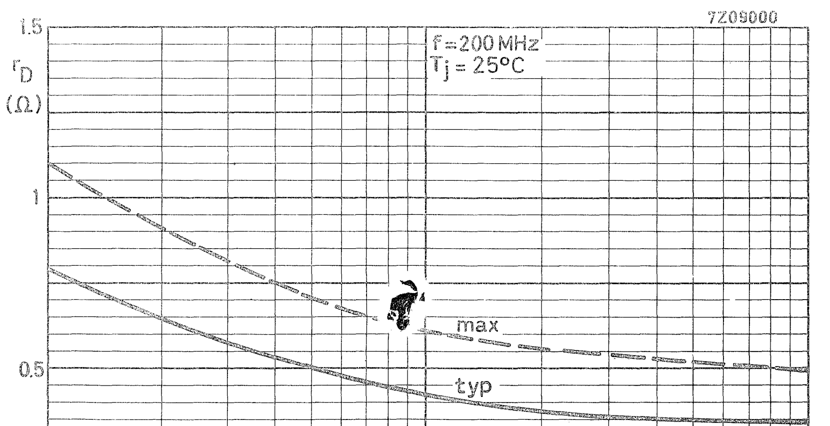

7Z08999
typical values
I_F
(mA)
100
50
0
$T_j = 60°C$
25°C
0
0.5
V_F (V)
1.0


7Z09001
typical values
I_R
(nA)
10
1
0.1
0.01
$T_j = 60°C$
25°C
1
10
V_R (V)
100


7Z08998
$V_R = 20V$
1
I_R
(nA)
0.1
0.01
typ
0
20
40
T_j (°C)
60


7Z08997
$V_R = 20V$
1000
I_R
(nA)
100
10
max
0
20
40
T_j (°C)
60


7Z09002
f = 1 MHz
Tj = 25°C
Cd (pF)
max
typ
min
0.1
1
10
VR (V)
100


7Z09000
f = 200 MHz
Tj = 25°C
rD (Ω)
max
typ
1
10
IF (mA)
100

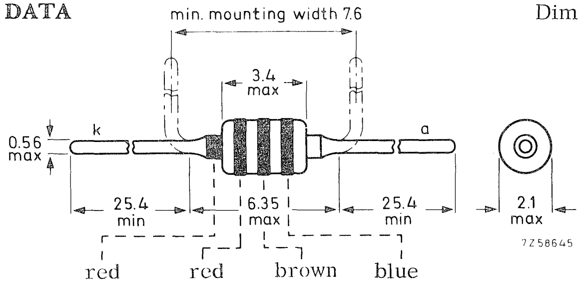
SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a hardglass subminiature envelope. The diode is intended for low voltage regulation such as bias stabilizer in class B output stages, clipping, clamping and meter protection.

QUICK REFERENCE DATA			
Repetitive peak reverse voltage	V_{RRM}	max.	10 V
Repetitive peak forward current	I_{FRM}	max.	150 mA
Storage temperature	T_{stg}		−65 to +200 °C
Junction temperature	T_j	max.	200 °C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.60 °C/mW
Forward voltage at I_F = 0.2 mA	V_F		500 to 620 mV
I_F = 3.0 mA	V_F		580 to 800 mV
I_F = 15 mA	V_F		700 to 1000 mV
Temperature coefficient at I_F = 3 mA	S_Z	typ.	−2 mV/°C

MECHANICAL DATA

Dimensions in mm



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

Voltages				
Repetitive peak reverse voltage	V_{RRM}	max	10	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA [1]
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.	1000	mA
t = 1 s	I_{FSM}	max.	250	mA
Temperatures				
Storage temperature	T_{stg}	-65 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.60	°C/mW

CHARACTERISTICS $T_j = 25\ ^\circ C$ unless otherwise specified

Forward voltage				
$I_F = 0.2$ mA	V_F	500 to	620	mV
$I_F = 3.0$ mA	V_F	580 to	800	mV
$I_F = 15$ mA	V_F	700 to	1000	mV
Reverse current				
$V_R = 10$ V	I_R	<	1500	nA

[1]) For sinusoidal operation $I_{FAV} = 48$ mA

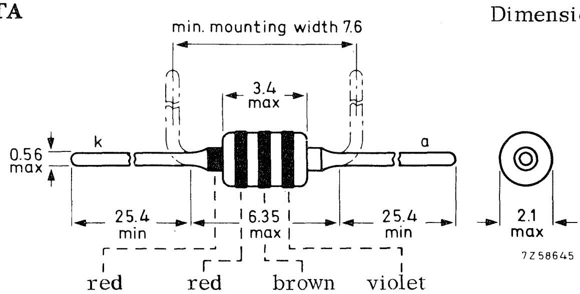
SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a hardglass subminiature envelope. This diode is intended for general purpose consumer applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	30	V
Repetitive peak forward current	I_{FRM}	max.	150	mA
Storage temperature	T_{stg}	-65 to	200	^oC
Junction temperature	T_j	max.	200	^oC
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.60	$^oC/mW$
Forward voltage at I_F = 1 mA	V_F	<	0.7	V
I_F = 10 mA	V_F	<	1.0	V
I_F = 50 mA	V_F	<	1.5	V

MECHANICAL DATA

Dimensions in mm



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

Voltages				
Continuous reverse voltage	V_R	max.	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	30	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA [1]
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	^{o}C
Junction temperature	T_j	max.	200	^{o}C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.60	^{o}C/mW

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

Forward voltage				
I_F = 1 mA	V_F	<	0.7	V
I_F = 10 mA	V_F	<	1.0	V
I_F = 50 mA	V_F	<	1.5	V
Reverse current				
V_R = 10 V	I_R	<	50	nA
V_R = 30 V	I_R	<	200	nA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	5	pF

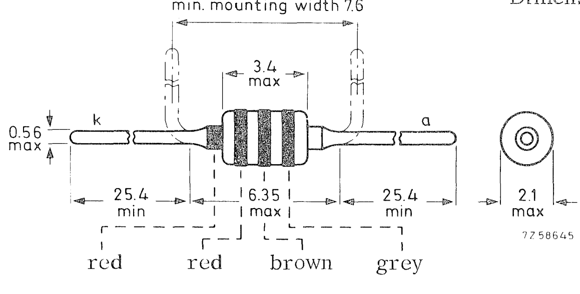
[1]) For sinusoidal operation I_{FAV} = 48 mA

SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a hardglass subminiature envelope. The diode is intended for general purpose consumer applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak forward current	I_{FRM}	max.	150	mA
Storage temperature	T_{stg}	-65 to	+200	^oC
Junction temperature	T_j	max.	200	^oC
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.60	$^oC/mW$
Forward voltage at I_F = 1 mA	V_F	<	0.7	V
I_F = 10 mA	V_F	<	1.0	V
I_F = 50 mA	V_F	<	1.5	V

MECHANICAL DATA Dimensions in mm



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

Voltages				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA [1]
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	$R_{th\ j\text{-}a}$	=	0.60	$^oC/mW$

CHARACTERISTICS

Forward voltage				
I_F = 1 mA	V_F	<	0.7	V
I_F = 10 mA	V_F	<	1.0	V
I_F = 50 mA	V_F	<	1.5	V
Reverse current				
V_R = 25 V	I_R	<	50	nA
V_R = 50 V	I_R	<	200	nA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	5	pF

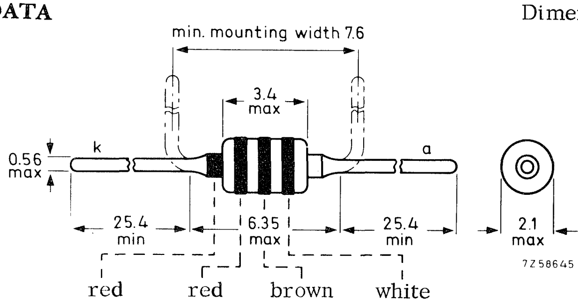
[1]) For sinusoidal operation I_{FAV} = 48 mA

SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a hardglass subminiature envelope. The diode is intended for general purpose consumer applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	100	V
Repetitive peak forward current	I_{FRM}	max.	300	mA
Storage temperature	T_{stg}		-65 to +200	^oC
Junction temperature	T_j	max.	200	^oC
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.60	^oC/mW
Forward voltage at I_F = 1 mA	V_F	<	0.65	V
I_F = 10 mA	V_F	<	0.85	V
I_F =100 mA	V_F	<	1.50	V

MECHANICAL DATA Dimensions in mm



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

Voltages

Continuous reverse voltage	V_R	max.	100	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	100	mA
Forward current (d. c.)	I_F	max.	100	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Non repetitive peak forward current				
$t = 1\ \mu s$	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	$R_{th\ j-a}$	=	0.60	$^oC/mW$

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

Forward voltage

$I_F = 1$ mA	V_F	<	0.65	V
$I_F = 10$ mA	V_F	<	0.85	V
$I_F = 100$ mA	V_F	<	1.50	V

Reverse current

$V_R = 50$ V	I_R	<	200	nA
$V_R = 100$ V	I_R	<	500	nA

Diode capacitance

$V_R = 0$; f = 1 MHz	C_d	<	5	pF

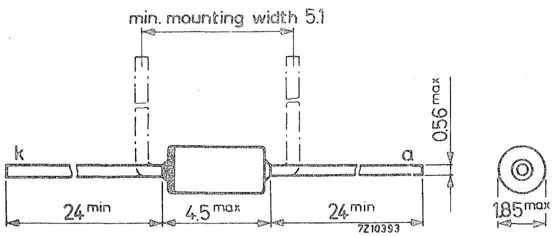
ULTRA HIGH SPEED DIODE

Silicon planar epitaxial ultra high speed high conductance diode in a DO-35 envelope. The BAV10 is primarily intended for core gating in very fast memories.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	60	V
Repetitive peak forward current	I_{FRM}	max.	600	mA
Junction temperature	T_j	max.	200	^oC
Forward voltage at I_F = 200 mA	V_F	<	1.0	V
Reverse recovery time when switched from I_F = 400 mA to I_R = 400 mA; R_L = 100 Ω measured at I_R = 40 mA	t_{rr}	<	6	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V; R_L = 500 Ω	Q_s	<	50	pC

MECHANICAL DATA Dimensions in mm

DO-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

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

Voltages				
Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	60	V [1])
Currents				
Average rectified forward current	I_{FAV}	max.	300	mA [2])
Forward current (d.c.)	I_F	max.	300	mA
Repetitive peak forward current	I_{FRM}	max.	600	mA
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	4000	mA
t = 1 s	I_{FSM}	max.	1000	mA
Temperatures				
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a}$	=	0.5	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltages				
I_F = 10 mA	V_F	<	750	mV
I_F = 200 mA	V_F	<	1.0	V
I_F = 200 mA; T_j = 100 °C	V_F	<	0.95	V
I_F = 500 mA	V_F	<	1.25	V
Reverse currents				
V_R = 60 V	I_R	<	100	nA
V_R = 60 V; T_j = 150 °C	I_R	<	100	μA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	2.5	pF

[1]) Measured at zero lifetime at I_R = 10 μA; V_R = 75 V.

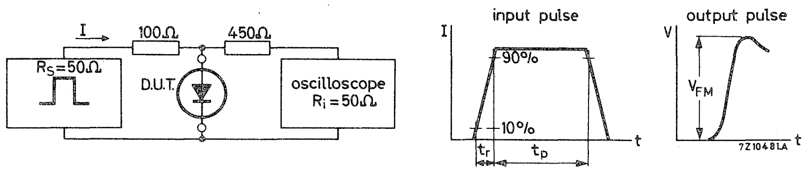
[2]) For sinusoidal operation see page 6. For pulse operation see page 5.

CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$ unless otherwise specified

Forward recovery voltage when switched to

$I_F = 400$ mA; $t_r = 30$ ns	V_{FM}	<	2.0 V
$I_F = 400$ mA; $t_r = 100$ ns	V_{FM}	<	1.5 V

Test circuit:



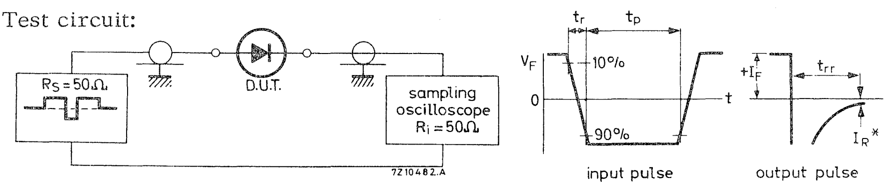
Current pulse:	Rise time	t_{r1} =	30 ns	Oscilloscope:			
	Rise time	t_{r2} =	100 ns				
	Pulse duration	t_p =	300 ns	Rise time	t_r	=	0.35 ns
	Duty cycle	δ =	0.01	Input capacitance	C_i	≤	1 pF

Circuit capacitance $C \leq 20$ pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

$I_F = 400$ mA to $I_{RM} = 400$ mA; $R_L = 100\ \Omega$
measured at $I_R = 40$ mA t_{rr} < 6 ns

Test circuit:



*) $I_R = 40$ mA

Reverse pulse:	Rise time	t_r =	0.6 ns	Oscilloscope:		
	Pulse duration	t_p =	100 ns	Rise time	t_r =	0.35 ns
	Duty cycle	δ =	0.05			

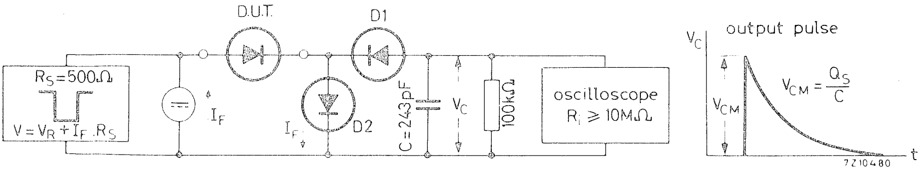
Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

CHARACTERISTICS (continued)

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω | Q_s | < | 50 | pC

Test circuit:



D1 = BAW62

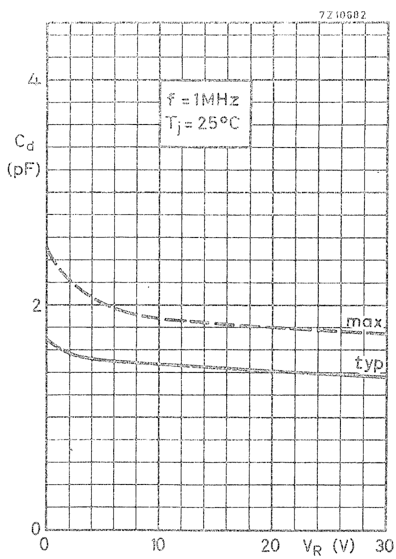
D2 = diode with minority carrier lifetime at 10 mA: < 200 ps

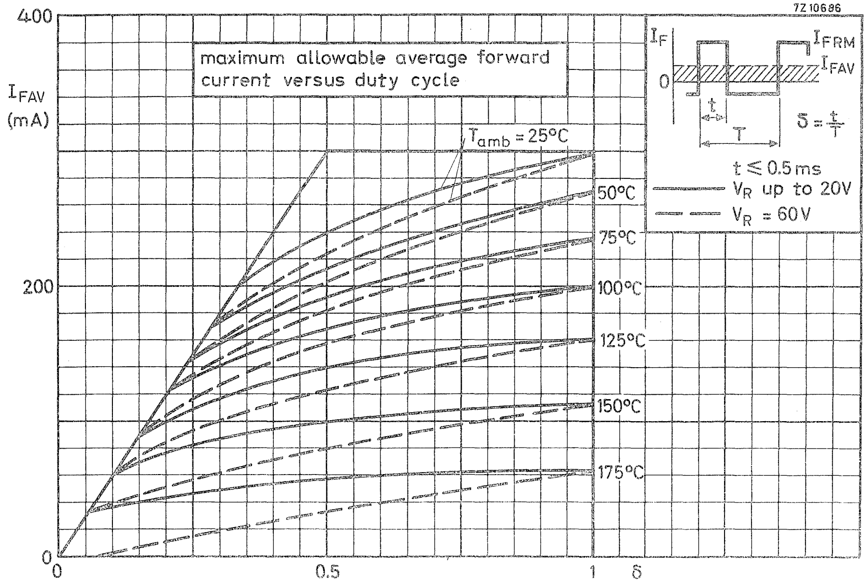
Reverse pulse : Rise time t_r = 2 ns

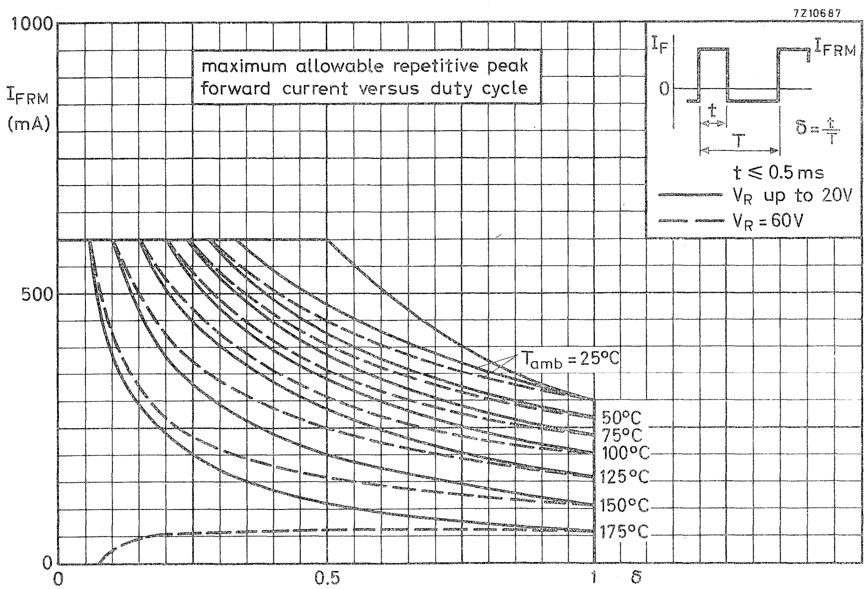
Pulse duration t_p = 400 ns

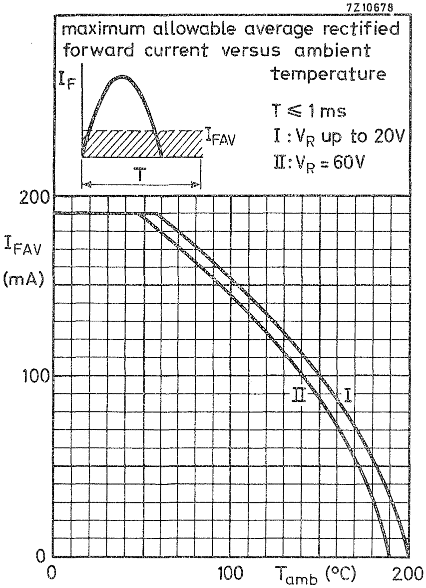
Duty cycle δ = 0.02

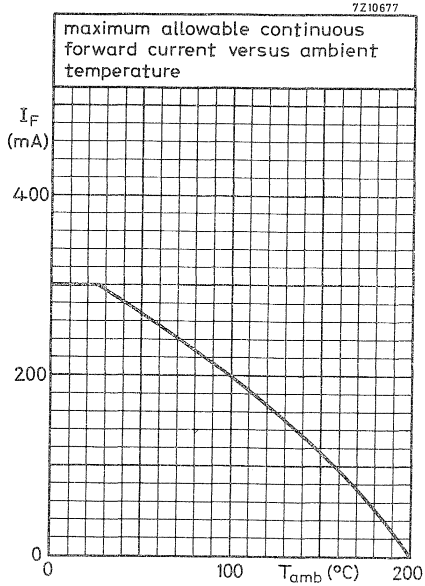
Circuit capacitance C ≤ 7 pF (C = Oscilloscope + parasitical capacitance)

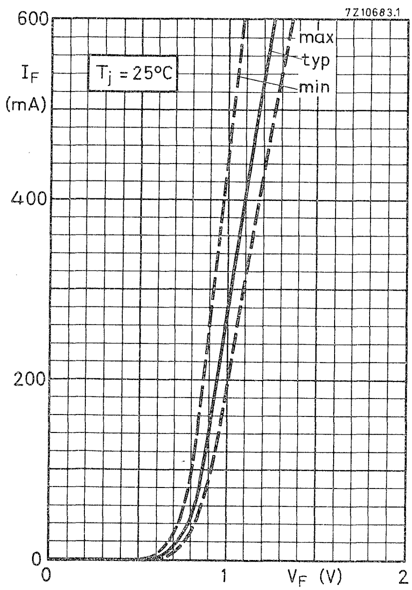


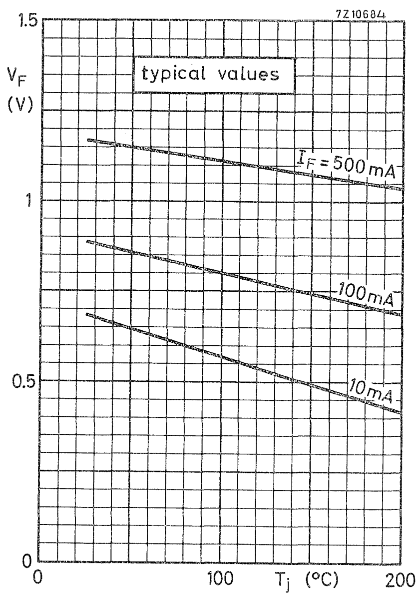

7Z10686
maximum allowable average forward current versus duty cycle
I_{FAV} (mA)
400
200
0
0
0.5
1
δ
T_{amb} = 25°C
50°C
75°C
100°C
125°C
150°C
175°C
I_F
I_{FRM}
I_{FAV}
0
t
T
δ = t/T
t ≤ 0.5 ms
V_R up to 20V
V_R = 60V

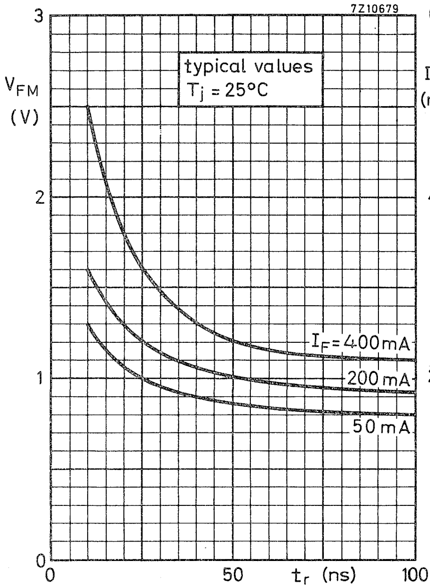

7Z10687
maximum allowable repetitive peak forward current versus duty cycle
I_{FRM} (mA)
1000
500
0
0
0.5
1
δ
T_{amb} = 25°C
50°C
75°C
100°C
125°C
150°C
175°C
I_F
I_{FRM}
0
t
T
δ = t/T
t ≤ 0.5 ms
V_R up to 20V
V_R = 60V

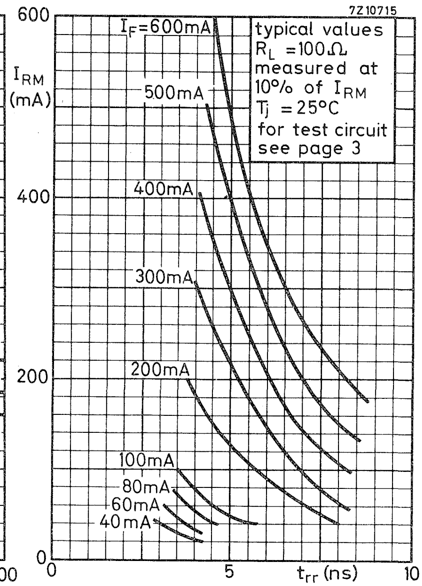

7Z10678
maximum allowable average rectified forward current versus ambient temperature
I_F
I_{FAV}
T
T ≤ 1 ms
I : V_R up to 20V
II: V_R = 60V
200
I_{FAV}
(mA)
100
II
I
0
0
100
T_{amb} (°C)
200

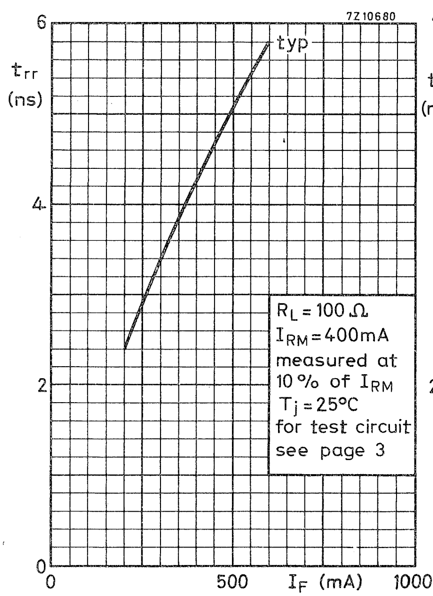

7Z10677
maximum allowable continuous forward current versus ambient temperature
I_F
(mA)
400
200
0
0
100
T_{amb} (°C)
200

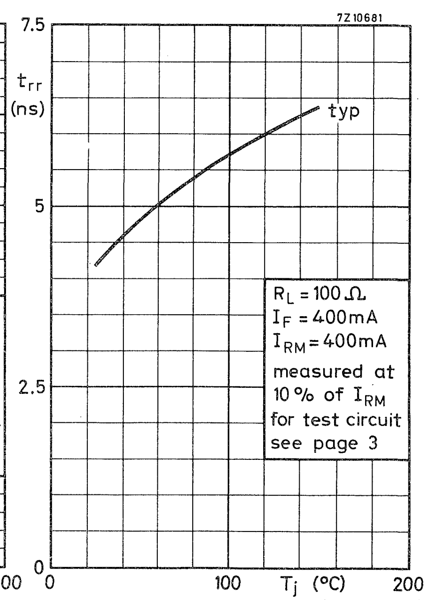

7Z10683.1
600
I_F
(mA)
T_j = 25°C
max
typ
min
400
200
0
0
1
V_F (V)
2

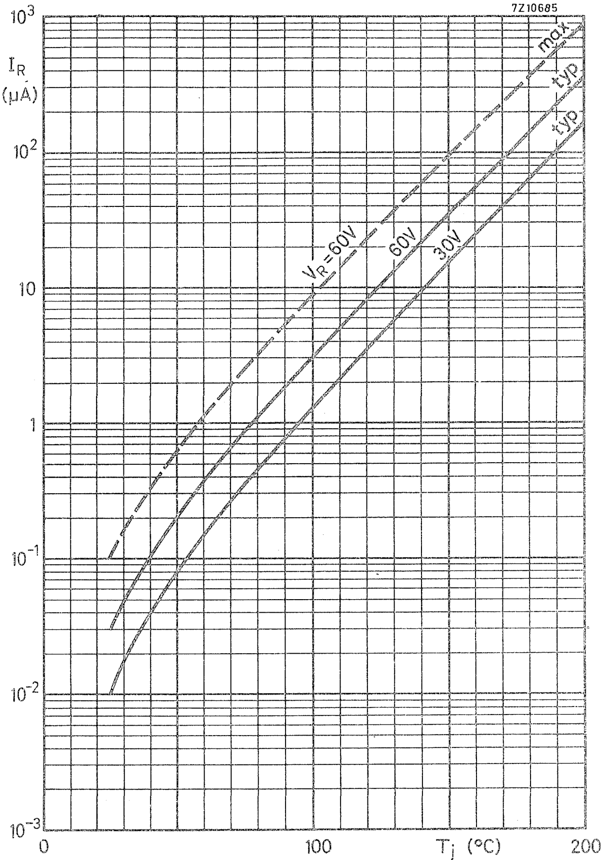

7Z10684
1.5
V_F
(V)
typical values
I_F = 500 mA
1
100 mA
0.5
10 mA
0
0
100
T_j (°C)
200


7Z10679
V_{FM} (V)
typical values
T_j = 25°C
I_F = 400mA
200 mA
50 mA
t_r (ns)
0
50
100
1
2
3


7Z10715
I_{RM} (mA)
typical values
R_L = 100 Ω
measured at 10% of I_{RM}
T_j = 25°C
for test circuit see page 3
I_F=600mA
500mA
400mA
300mA
200mA
100mA
80mA
60mA
40mA
t_{rr} (ns)
0
5
10
200
400
600


7Z10680
t_{rr} (ns)
typ
R_L = 100 Ω
I_{RM} = 400mA
measured at 10 % of I_{RM}
T_j = 25°C
for test circuit see page 3
I_F (mA)
0
500
1000
2
4
6


7Z10681
t_{rr} (ns)
typ
R_L = 100 Ω
I_F = 400mA
I_{RM} = 400mA
measured at 10 % of I_{RM}
for test circuit see page 3
T_j (°C)
0
100
200
2.5
5
7.5


7Z10685
10^3
I_R (µA)
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
0
100
T_j (°C)
200
max
typ
typ
V_R=60V
60V
30V

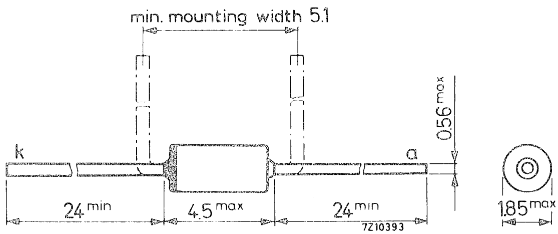
HIGH SPEED SILICON DIODES

Silicon planar epitaxial high speed diode in a DO-35 envelope.
The BAW62 is primarily intended for fast logic applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	V
Repetitive peak forward current	I_{FRM}	max.	225	mA
Junction temperature	T_j	max.	200	^oC
Forward voltage at I_F = 100 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-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

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

Voltages				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	V [1])
Currents				
Average rectified forward current	I_{FAV}	max.	100	mA [2])
Forward current (d.c.)	I_F	max.	100	mA
Repetitive peak forward current	I_{FRM}	max.	225	mA
Non repetitive peak forward current $t = 1\,\mu s$	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.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a}$	=	0.6	°C/mW

CHARACTERISTICS $T_j = 25$ °C unless otherwise specified

Forward voltages				
$I_F = 5$ mA	V_F		0.62 to 0.75	V
$I_F = 100$ mA	V_F	<	1	V
$I_F = 100$ mA; $T_j = 100$ °C	V_F	<	0.93	V
Reverse currents				
$V_R = 20$ V	I_R	<	25	nA
$V_R = 20$ V; $T_j = 150$ °C	I_R	<	50	µA
$V_R = 75$ V	I_R	<	5	µA
$V_R = 75$ V; $T_j = 150$ °C	I_R	<	100	µA
Diode capacitance				
$V_R = 0$; $f = 1$ MHz	C_d	<	2	pF

[1]) Measured at zero lifetime at $I_R = 100\ \mu A$; $V_R > 100$ V.

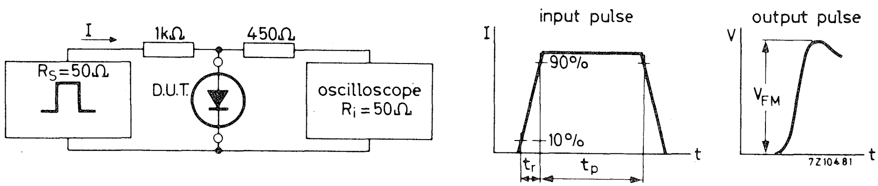
[2]) For sinusoidal operation see page 6. For pulse operation see page 5.

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

Forward recovery voltage when switched to

I_F = 50 mA; t_r = 20 ns V_{FM} < 2.5 V

Test circuit:



Current pulse: Rise time t_r = 20 ns Oscilloscope:

Pulse duration t_p = 120 ns Rise time t_r = 0.35 ns

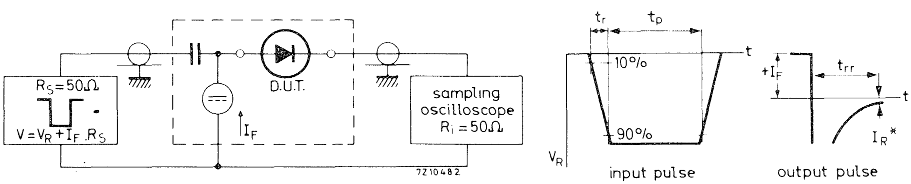
Duty cycle δ = 0.01

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

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:



*) I_R = 1 mA

Reverse pulse: Rise time t_r = 0.6 ns Oscilloscope:

Pulse duration t_p = 100 ns Rise time t_r = 0.35 ns

Duty cycle δ = 0.05

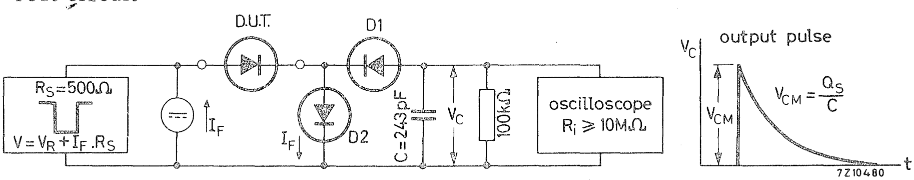
Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

CHARACTERISTICS (continued)

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω — Q_s typ. 50 pC

Test circuit



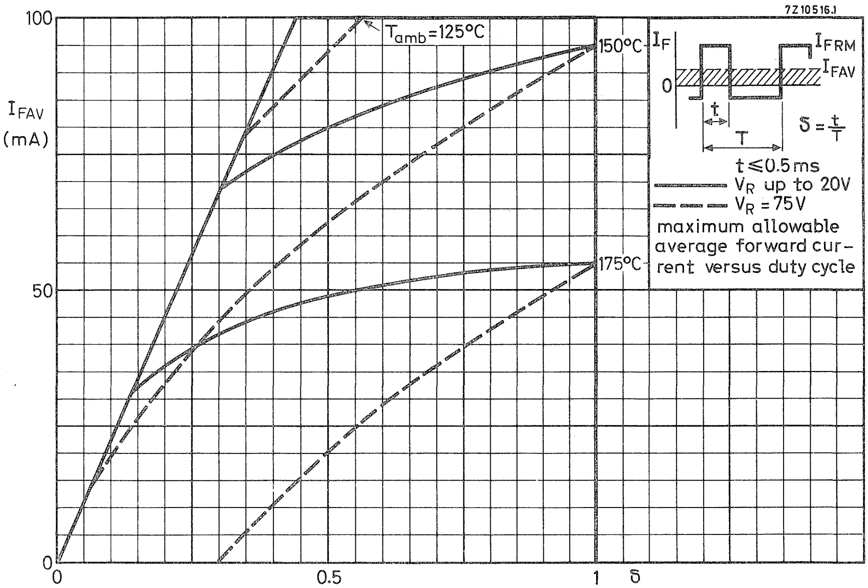
D1 = D2 = BAW62

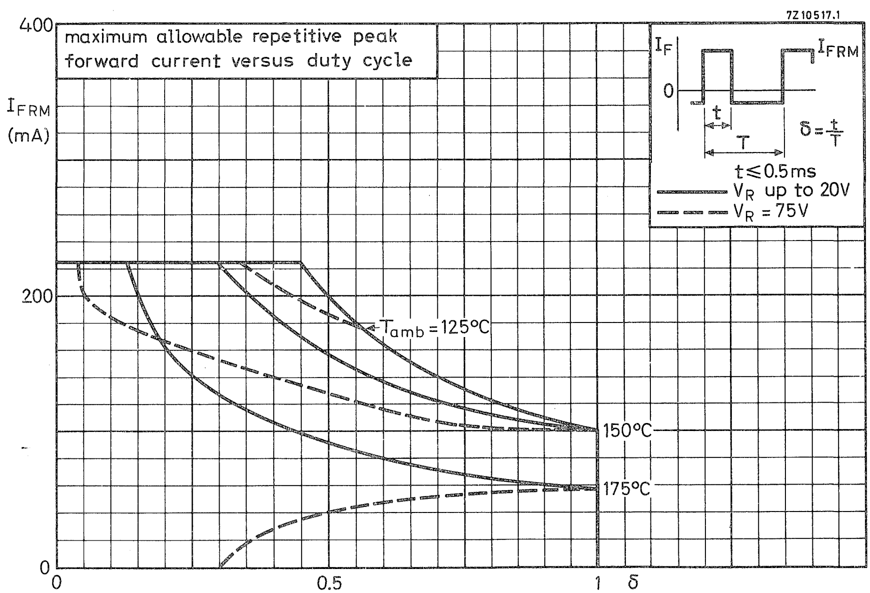
Reverse pulse: Rise time t_r = 2 ns

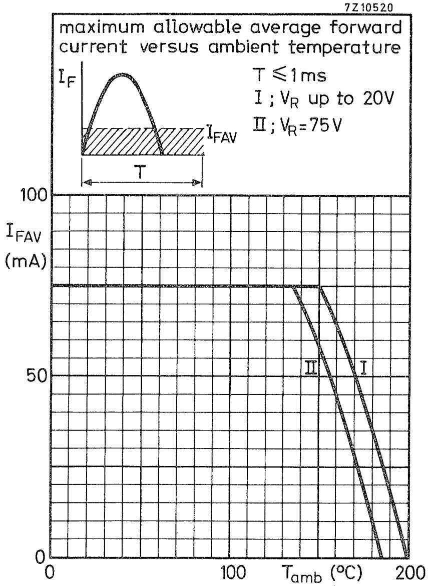
Pulse duration t_p = 400 ns

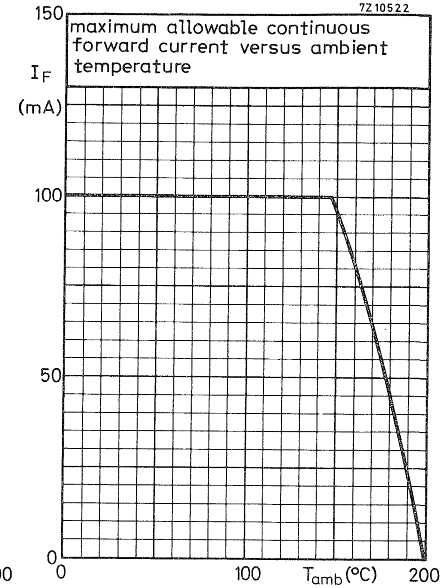
Duty cycle δ = 0.02

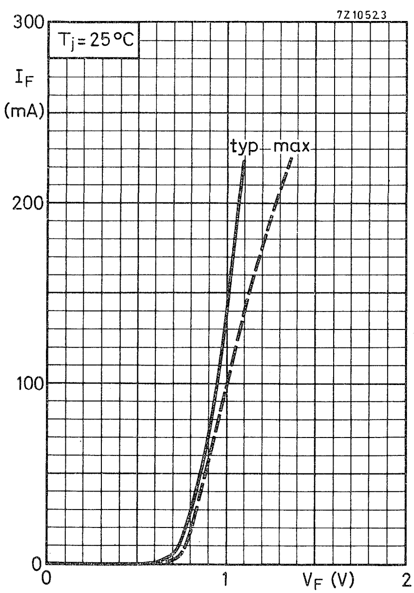
Circuit capacitance $C \leq 7$ pF (C = Oscilloscope + parasitical capacitance)

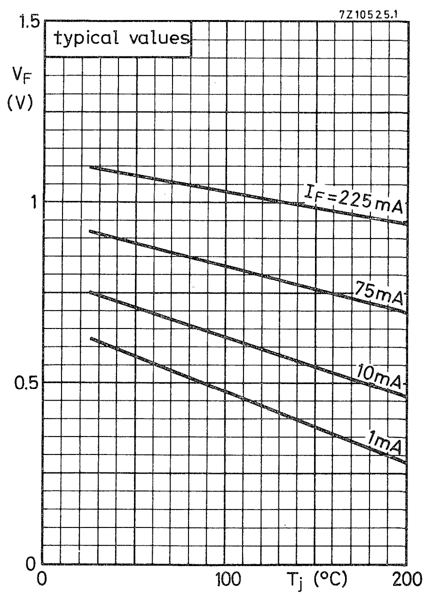

7Z10516.1
100
50
0
I_{FAV} (mA)
T_{amb}=125°C
150°C
175°C
0
0.5
1
δ
I_F
I_{FRM}
I_{FAV}
0
t
T
$\delta = \frac{t}{T}$
t ≤ 0.5 ms
V_R up to 20V
V_R = 75V
maximum allowable average forward current versus duty cycle

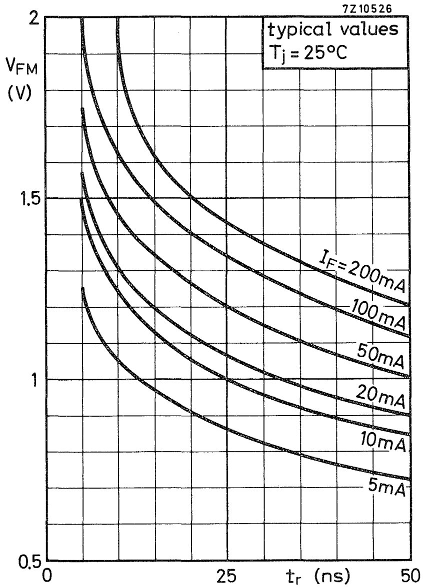

7Z10517.1
400
200
0
I_{FRM} (mA)
maximum allowable repetitive peak forward current versus duty cycle
T_{amb}=125°C
150°C
175°C
0
0.5
1
δ
I_F
I_{FRM}
0
t
T
$\delta = \frac{t}{T}$
t ≤ 0.5 ms
V_R up to 20V
V_R = 75V

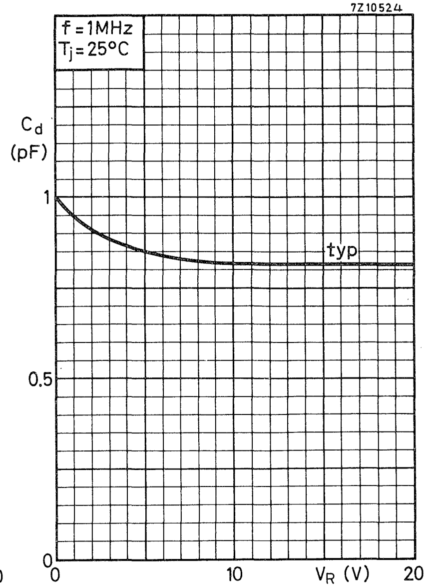

7Z10520
maximum allowable average forward current versus ambient temperature
I_F
I_FAV
T
T ≤ 1 ms
I ; V_R up to 20V
II ; V_R = 75 V
100
I_FAV
(mA)
50
0
0
100
T_amb (°C)
200
II
I

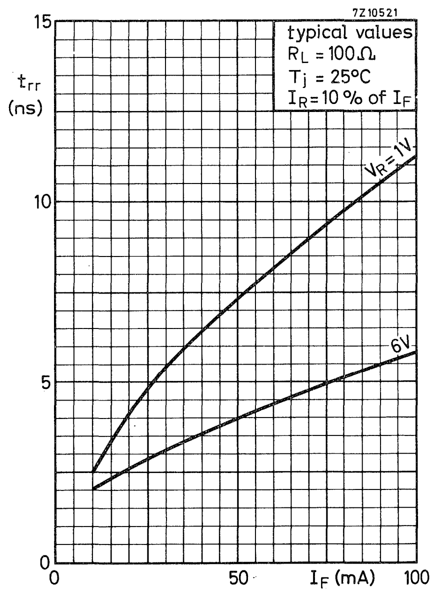

7Z10522
maximum allowable continuous forward current versus ambient temperature
150
I_F
(mA)
100
50
0
0
100
T_amb (°C)
200

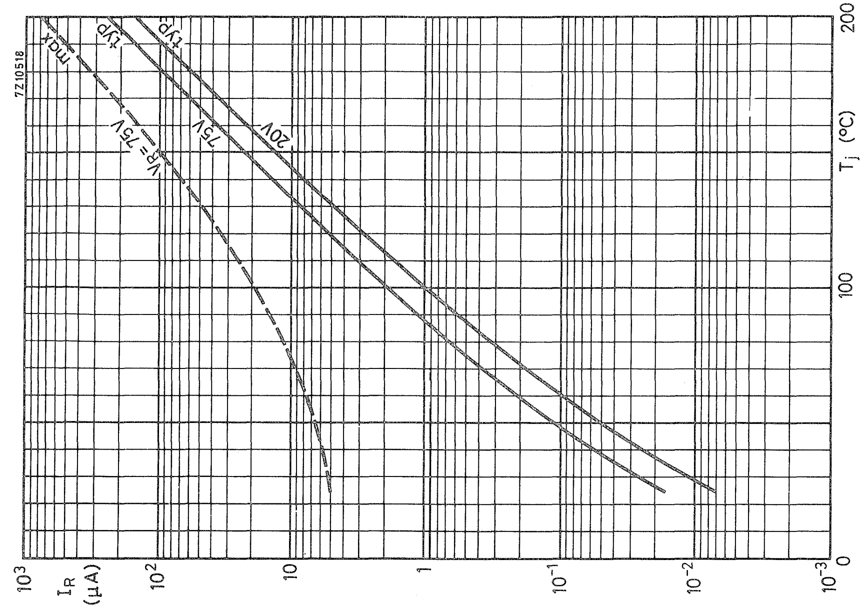

7Z10523
T_j = 25 °C
300
I_F
(mA)
200
100
0
0
1
V_F (V)
2
typ
max

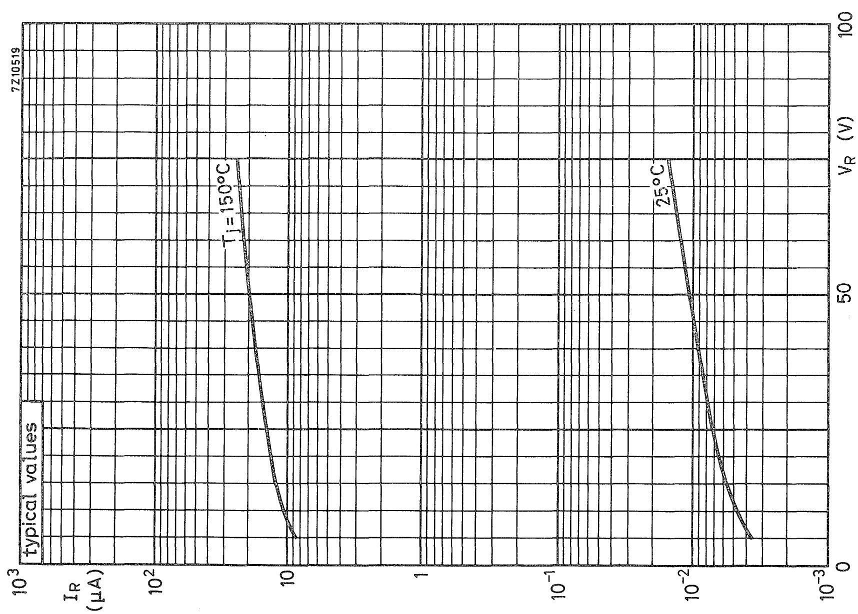

7Z10525.1
typical values
1.5
V_F
(V)
1
0.5
0
0
100
T_j (°C)
200
I_F = 225 mA
75mA
10mA
1mA


7Z10526
typical values
Tj = 25°C
VFM
(V)
2
1.5
1
0.5
0
25
tr (ns)
50
IF=200mA
100mA
50mA
20mA
10mA
5mA


7Z10524
f = 1MHz
Tj = 25°C
Cd
(pF)
1
0.5
0
10
VR (V)
20
typ


7Z10521
typical values
RL = 100Ω
Tj = 25°C
IR = 10 % of IF
trr
(ns)
15
10
5
0
50
IF (mA)
100
VR=1V
6V


7Z10518
max
typ
typ
V_R = 75V
75V
20V
I_R (μA)
10^3
10^2
10
1
10^-1
10^-2
10^-3
T_j (°C)
0
100
200


7Z10519
typical values
T_j = 150°C
25°C
I_R (μA)
10^3
10^2
10
1
10^-1
10^-2
10^-3
V_R (V)
0
50
100

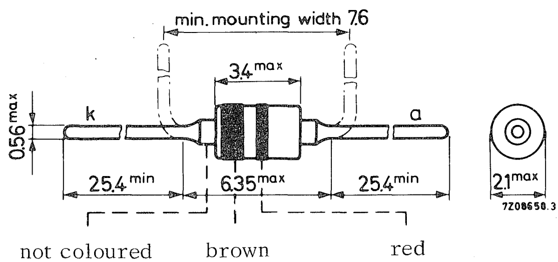
SILICON OXIDE PASSIVATED AVALANCHE DIODE

Whiskerless diffused diode in a molybdenum hard glass subminiature envelope, capable of absorbing transients repetitively. It is a fast high conductance diode, primarily intended for switching inductive loads in semi-electronic telephone exchanges.

QUICK REFERENCE DATA

Repetitive peak forward current	I_{FRM}	max.	800	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.3	°C/mW
Forward voltage at I_F = 200 mA	V_F	<	1.0	V
Reverse breakdown voltage I_R = 1 mA	$V_{(BR)R}$		120 to 175	V
Reverse recovery time when switched from I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 3 mA	t_{rr}	<	50	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	<	0.5	nC

MECHANICAL DATA Dimensions in mm



RATINGS (Limiting values) [1]

Voltage

Continuous reverse voltage	V_R	max.	90	V [2]

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	400	mA
Forward current (d.c.)	I_F	max.	400	mA
Repetitive peak forward current	I_{FRM}	max.	800	mA
Non repetitive peak forward current				
$t = 1\ \mu s$	I_{FSM}	max.	6000	mA
$t = 1$ s	I_{FSM}	max.	1500	mA
Repetitive peak reverse current	I_{RRM}	max.	600	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	$R_{th\ j\text{-}a}$	=	0.3	$^oC/mW$

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

Forward voltage

$I_F = 10$ mA	V_F	<	0.75	V
$I_F = 50$ mA	V_F	<	0.84	V
$I_F = 100$ mA	V_F	<	0.90	V
$I_F = 200$ mA	V_F	<	1.0	V
$I_F = 400$ mA	V_F	<	1.25	V

Reverse breakdown voltage

$I_R = 1$ mA	$V_{BR(R)}$	120 to	175	V

Reverse current

$V_R = 90$ V; $T_j = 150\ ^oC$	I_R	<	100	μA

Diode capacitance

$V_R = 0$; $f = 1$ MHz	C_d	typ.	25	pF
		<	35	pF

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

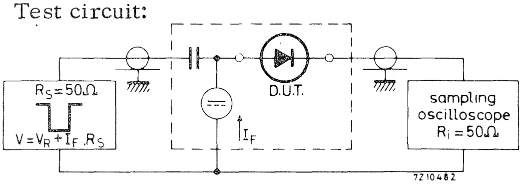
[2] It is allowed to exceed this value as described on page 4. Care should be taken not to exceed the I_{RRM} rating.

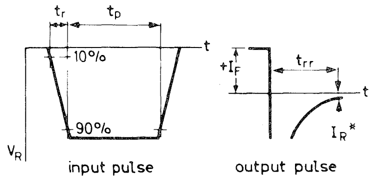
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Reverse recovery time when switched from

I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	typ.	37	ns
		<	60	ns
measured at I_R = 3 mA	t_{rr}	typ.	30	ns
		<	50	ns

Test circuit:





*) I_R = 1 mA (resp. 3 mA)

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

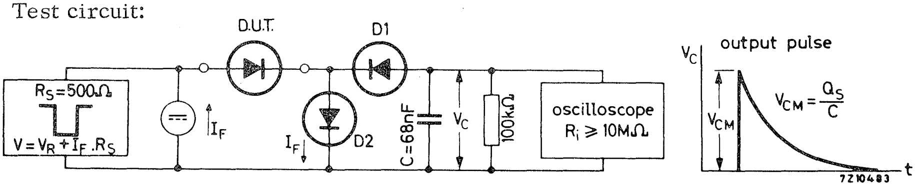
Oscilloscope:
Rise time t_r = 0.35 ns

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 < 0.5 nC

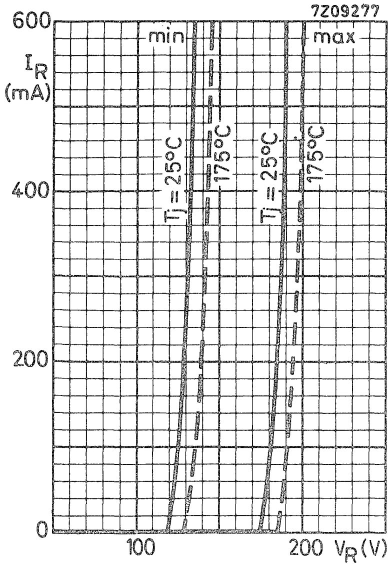
Test circuit:



D1 = D2 = BAW62

Reverse pulse: Rise time t_r = 15 ns
Pulse duration t_p = 35 μs
Frequency f = 25 kHz

Circuit capacitance C < 30 pF (C = Oscilloscope + parasitical capacitance)

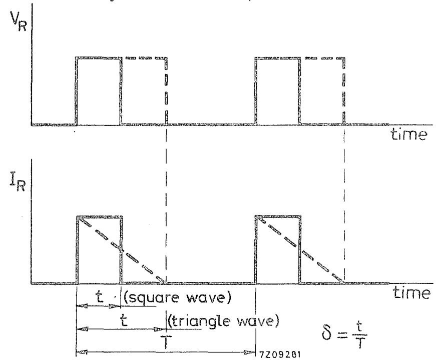


Reverse voltages higher than the V_R ratings are allowed, provided

a. the transient energy $\leq$ 5 mWs at $T_j = 25\,^oC$

b. $T \geq 50$ ms: $\delta \leq 0.01$ (square wave pulse)
$\delta \leq 0.02$ (triangle wave pulse)

With increasing temperature, the maximum allowable transient energy must be decreased by 0.015 mWs/°C.



EXAMPLE for calculating the maximum allowable drive current and the maximum turn off time in a practical circuit (see fig. 1)

1. Maximum allowable drive current

For the circuit shown it can be calculated with $E = \frac{1}{2} LI^2$

$$I_{drive\ max.} = \sqrt{\frac{5 \times 10^{-3}}{\frac{1}{2} \times 0.6}} = 130 \text{ mA}$$

2. Maximum turn off time

Immediately after opening switch S the reverse current of the diode is $I_R = I_{drive}$

The turn off time $t_{off} = \frac{E}{\frac{1}{2} \times I_R \times V_{(BR)R}}$. It will be maximum for devices with minmum breakdown voltage if the maximum drive current is applied.

Hence $t_{off\ max.} = \frac{5 \times 10^{-3}}{\frac{1}{2} \times 130 \times 10^{-3} \times 120} = 0.6$ ms

For $I_{drive} = 100$ mA: $t_{off\ max} = \frac{\frac{1}{2} \times 0.6 \times 10^{-2}}{\frac{1}{2} \times 100 \times 10^{-3} \times 120} = 0.5$ ms

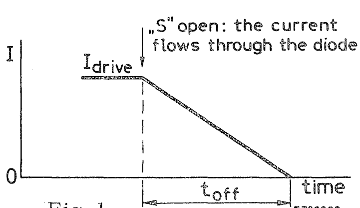


Fig. 1

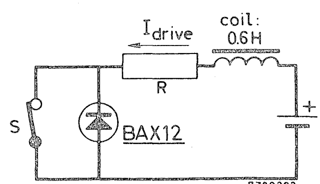
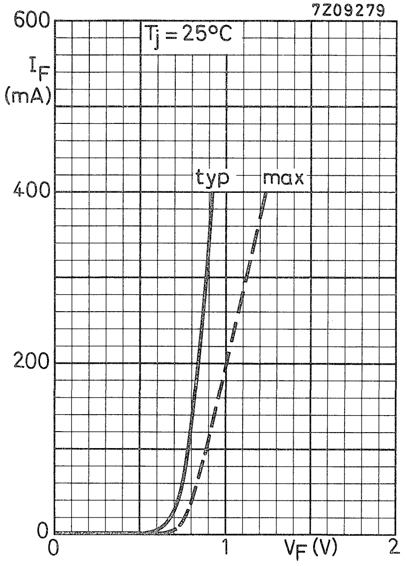
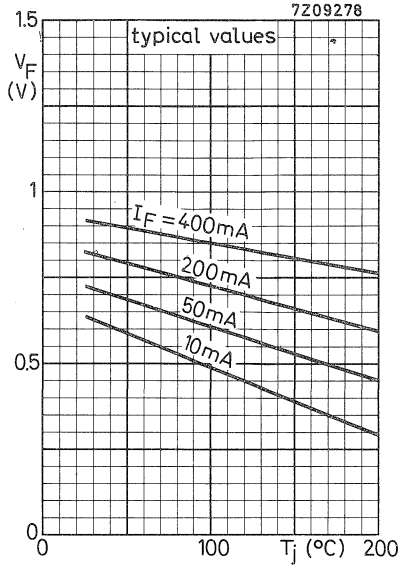
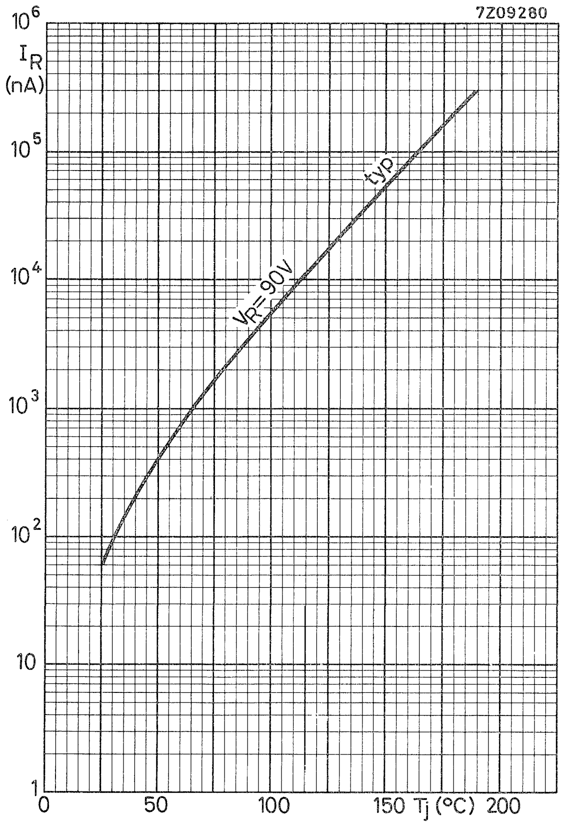


Fig. 2


7Z09279
600
I_F
(mA)
$T_j = 25°C$
typ
max
400
200
0
0
1
V_F (V)
2


7Z09278
1.5
V_F
(V)
typical values
1
I_F = 400mA
200mA
50mA
10mA
0.5
0
0
100
T_j (°C)
200

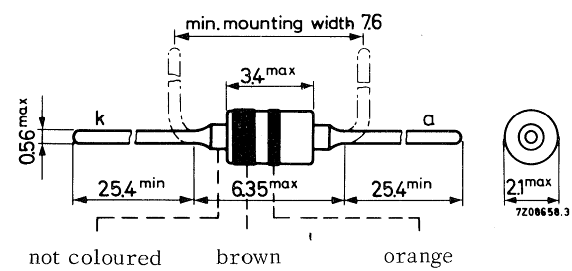

7Z09280
10^6
I_R
(nA)
10^5
10^4
10^3
10^2
10
1
0
50
100
150
200
T_j (°C)
typ
$V_R = 90V$

SILICON OXIDE PASSIVATED DIODE

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

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	V
Repetitive peak forward current	I_{FRM}	max.	150	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.60	^{o}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



RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage	V_R	max.	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	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 $t = 1\ \mu s$	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	$R_{th\ j\text{-}a}$	=	0.60	$^oC/mW$

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 [3]
$I_F = 75$ mA	V_F	<	1.53	V [3]

Reverse current

$V_R = 10$ V	I_R	<	25	nA
$V_R = 10$ V; $T_j = 150\ ^oC$	I_R	<	10	μA
$V_R = 25$ V	I_R	<	50	nA
$V_R = 50$ V	I_R	<	200	nA
$V_R = 50$ V; $T_j = 150\ ^oC$	I_R	<	25	μA

Diode capacitance (see also page 7)

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

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

[2] For sinusoidal operation see page 5.
For pulse operation see page 6.

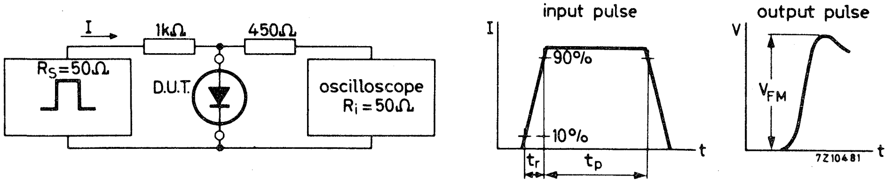
[3] Measured under pulsed conditions to prevent excessive dissipation.

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

Forward recovery voltage (see also page 7)

At t_r > 20 ns, V_{FM} will not exceed V_F corresponding to I_F = 1 to 75 mA

Test circuit:



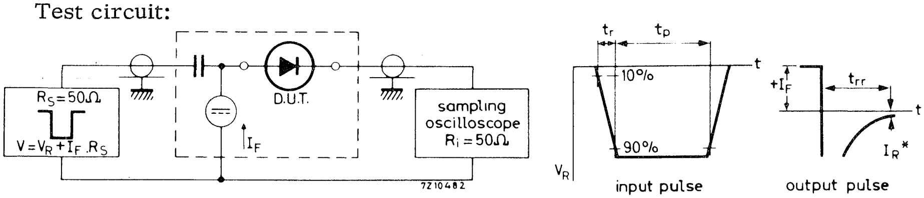
Current pulse:	Rise time	t_r	=	20	ns	Oscilloscope:			
	Pulse duration	t_p	=	120	ns	Rise time	t_r	=	0.35 ns
	Duty cycle	δ	=	0.01					

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

Reverse recovery time when switched from

I_F = 10 mA to V_R ; R_L = 100 Ω (see also page 8)
measured at I_R = 1 mA; switched to V_R = 1 V t_{rr} < 6 ns
V_R = 6 V t_{rr} < 4 ns

Test circuit:



*) I_R = 1 mA

Reverse pulse:	Rise time	t_r	=	0.6	ns	Oscilloscope:			
	Pulse duration	t_p	=	100	ns	Rise time	t_r	=	0.35 ns
	Duty cycle	δ	=	0.05					

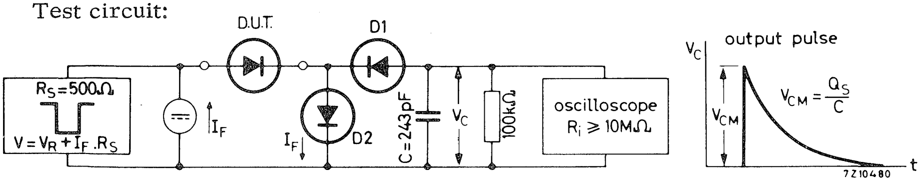
Circuit capacitance C $\leq$ 1 pF (C = Oscilloscope + parasitical capacitance)

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

Recovered charge when switched from

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

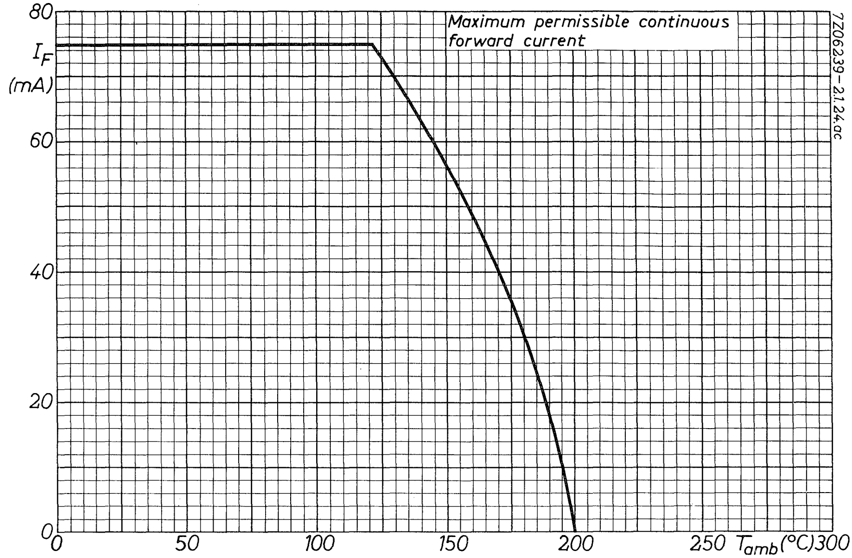
Test circuit:

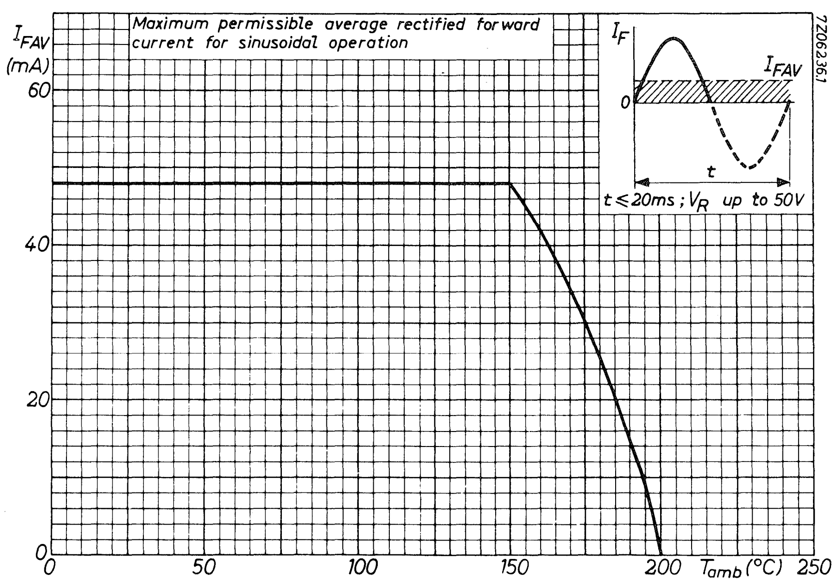


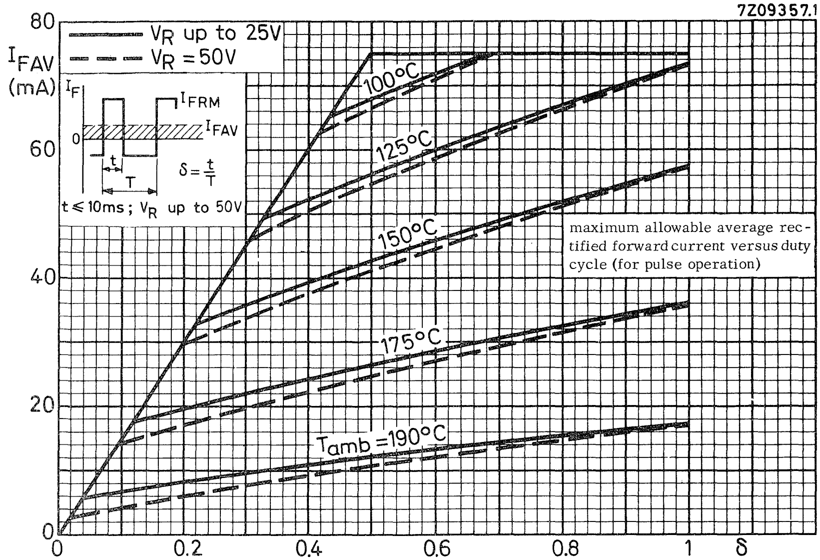
D1 = D2 = BAW62

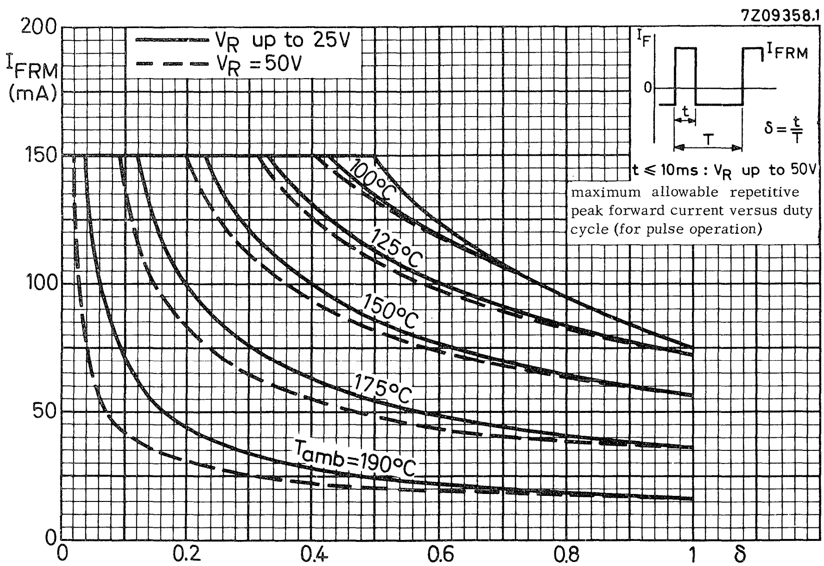
Reverse pulse:	Rise time	t_r	=	2 ns
	Pulse duration	t_p	=	400 ns
	Duty cycle	δ	=	0.02

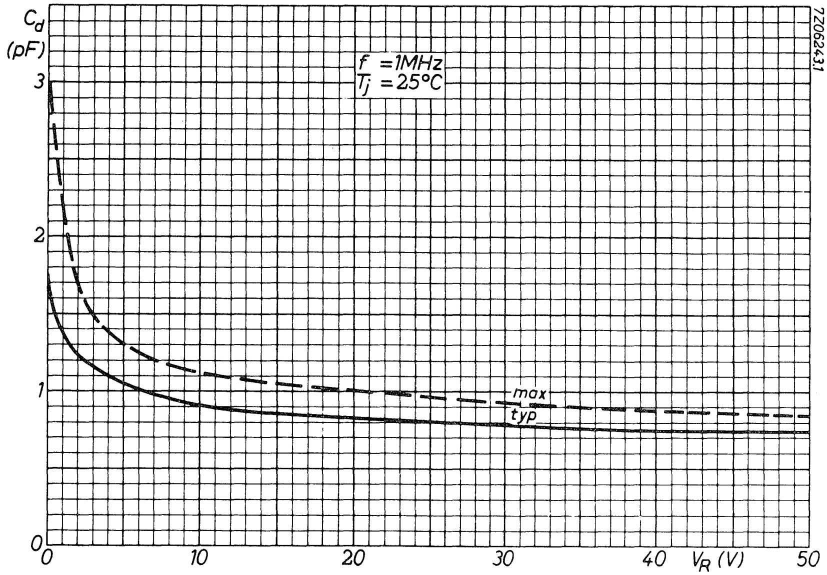
Circuit capacitance C < 7 pF (C = Oscilloscope + parasitical capacitance)

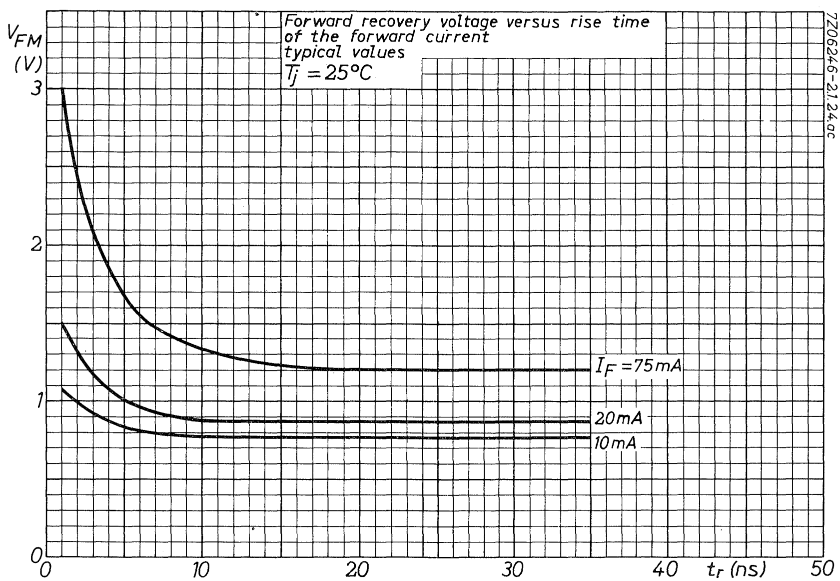

Maximum permissible continuous forward current
7Z06239-2.1.24.ac
80
I_F (mA)
60
40
20
0
0
50
100
150
200
250
T_{amb} (°C)
300

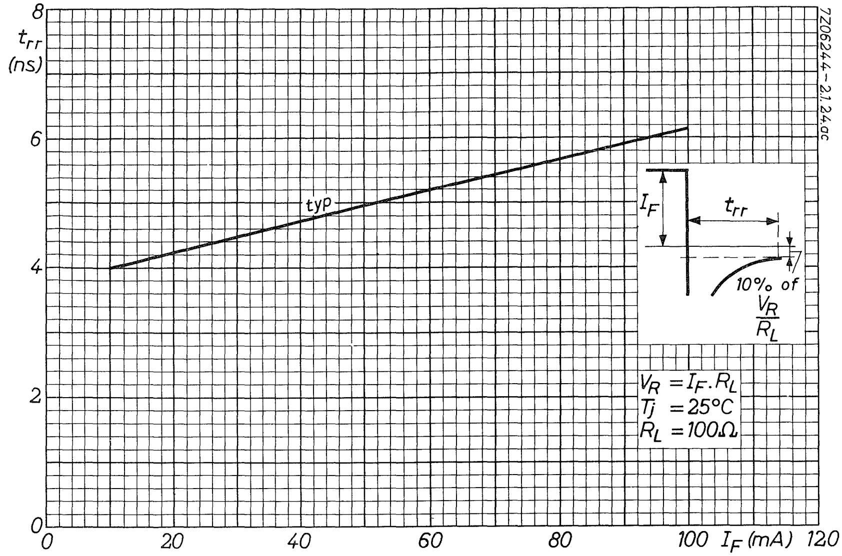

Maximum permissible average rectified forward current for sinusoidal operation
7Z06236.1
I_{FAV} (mA)
60
40
20
0
0
50
100
150
200
T_{amb} (°C)
250
I_F
I_{FAV}
0
t
$t \leq 20$ms ; V_R up to 50V

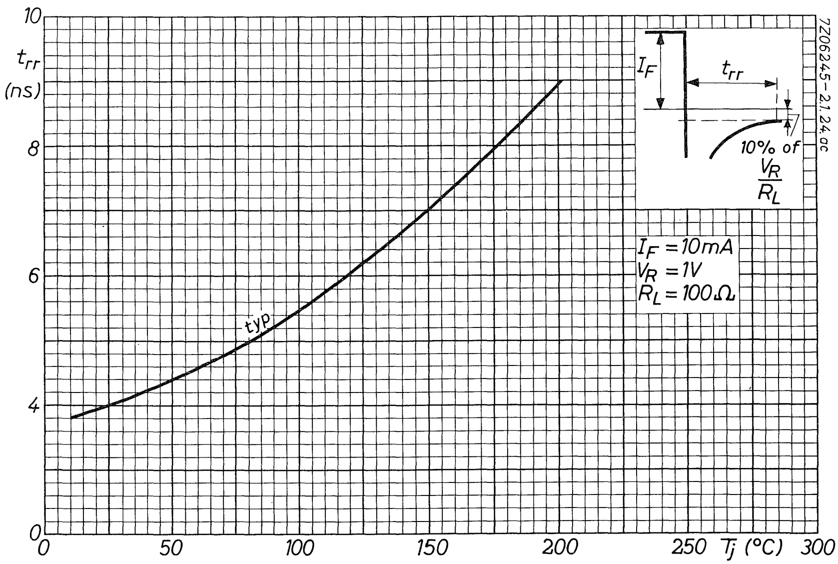

7Z09357.1
80
60
40
20
0
I_{FAV} (mA)
V_R up to 25V
V_R = 50V
I_F
I_{FRM}
I_{FAV}
0
t
T
$\delta = \frac{t}{T}$
t ≤ 10ms ; V_R up to 50V
100°C
125°C
150°C
175°C
T_{amb} = 190°C
maximum allowable average rectified forward current versus duty cycle (for pulse operation)
0
0.2
0.4
0.6
0.8
1
δ

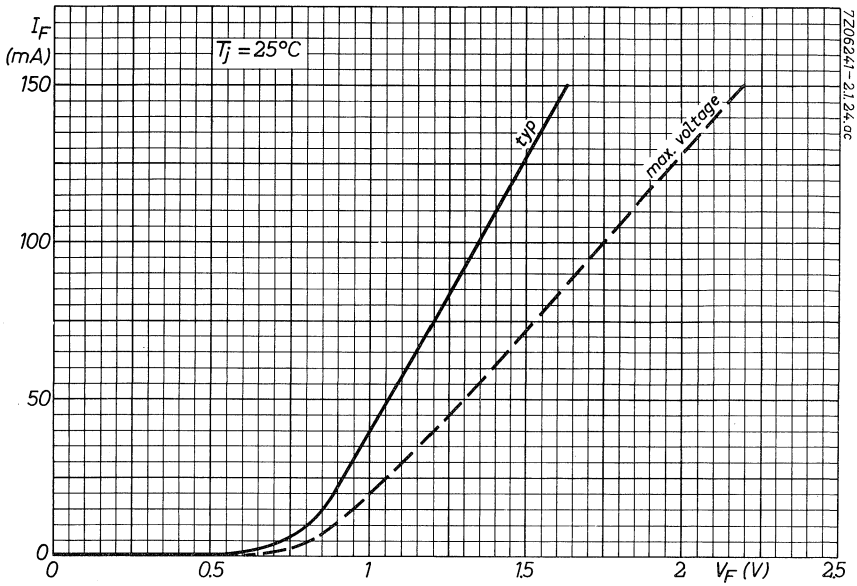

7Z09358.1
200
150
100
50
0
I_{FRM} (mA)
V_R up to 25V
V_R = 50V
I_F
I_{FRM}
0
t
T
$\delta = \frac{t}{T}$
t ≤ 10ms : V_R up to 50V
maximum allowable repetitive peak forward current versus duty cycle (for pulse operation)
100°C
125°C
150°C
175°C
T_{amb} = 190°C
0
0.2
0.4
0.6
0.8
1
δ


7Z06243.1
C_d
(pF)
f = 1MHz
T_j = 25°C
max
typ
V_R (V)
0
1
2
3
0
10
20
30
40
50

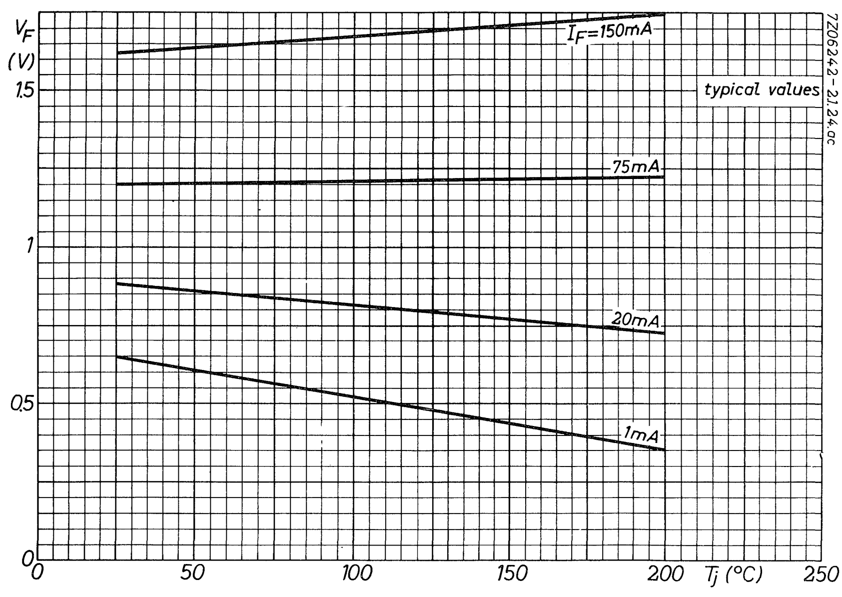

7Z06246-2.1.24.ac
V_{FM}
(V)
Forward recovery voltage versus rise time
of the forward current
typical values
T_j = 25°C
I_F = 75mA
20mA
10mA
t_r (ns)
0
1
2
3
0
10
20
30
40
50


7Z06244-2.1.24.ac
t_{rr} (ns)
typ
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F . R_L$
$T_j = 25°C$
$R_L = 100\Omega$
I_F (mA)
0 20 40 60 80 100 120
0 2 4 6 8

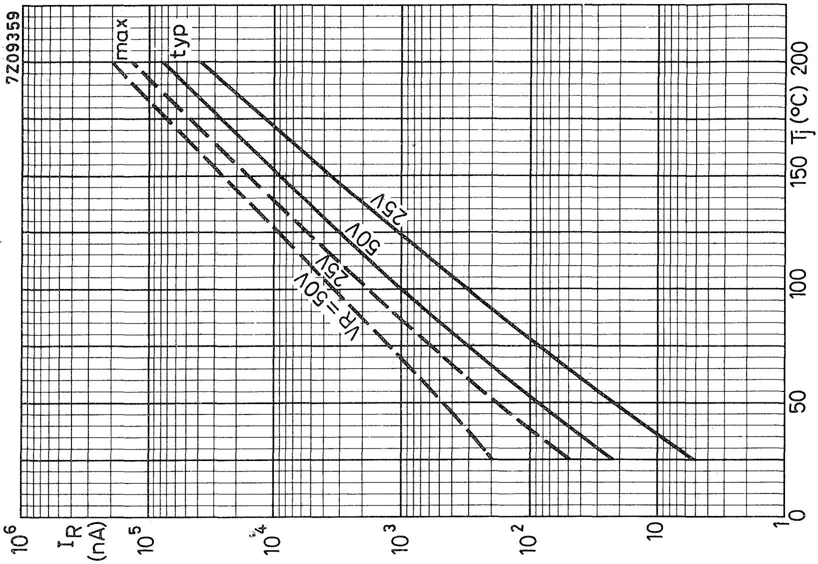

7Z06245-2.1.24.ac
t_{rr} (ns)
typ
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$I_F = 10 mA$
$V_R = 1V$
$R_L = 100\Omega$
T_j (°C)
0 50 100 150 200 250 300
0 4 6 8 10

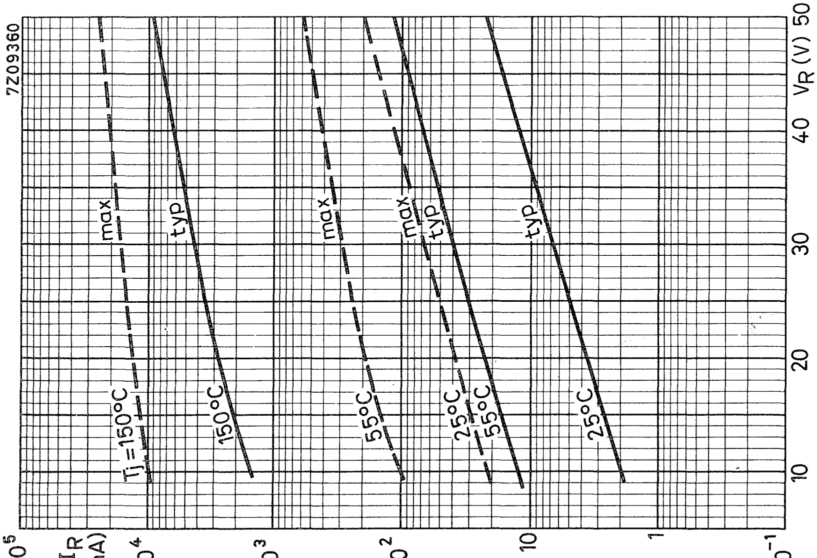


I_F (mA)
$T_j = 25°C$
typ
max. voltage
7Z06241-2.1.24.ac
0
50
100
150
0
0.5
1
1.5
2
2.5
V_F (V)



V_F (V)
I_F=150mA
typical values
75mA
20mA
1mA
7Z06242-2.1.24.ac
0
0.5
1
1.5
0
50
100
150
200
250
T_j (°C)


7Z09359
max
typ
25V
50V
25V
V_R = 50V
T_j (°C)
200
150
100
50
0
I_R (nA)
10^6
10^5
10^4
10^3
10^2
10
1

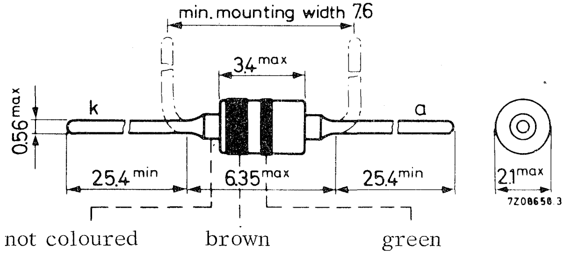

7Z09360
max
typ
T_j = 150°C
150°C
max
55°C
max
typ
25°C
55°C
typ
25°C
V_R (V)
50
40
30
20
10
I_R (nA)
10^5
10^4
10^3
10^2
10
1
10^{-1}

SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a subminiature envelope. The BAX15 is primarily intended for general purpose industrial applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	150	V
Repetitive peak reverse voltage	V_{RRM}	max.	180	V
Repetitive peak forward current	I_{FRM}	max.	500	mA
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.4	°C/mW
Forward voltage at I_F = 100 mA	V_F	<	1.0	V
Reverse recovery time when switched from I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	300	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	typ.	1	nC

MECHANICAL DATA Dimensions in mm



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

Voltages

Continuous reverse voltage	V_R	max.	150	V
Repetitive peak reverse voltage	V_{RRM}	max.	180	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	250	mA [1])
Forward current (d.c.)	I_F	max.	250	mA
Repetitive peak forward current	I_{FRM}	max.	500	mA
Non repetitive peak forward current; $t \leq 10\ \mu s$	I_{FSM}	max.	30	A

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	$R_{th\ j\text{-}a}$	=	0.4	$^oC/mW$

CHARACTERISTICS T_j = 25 ^oC unless otherwise specified

Forward voltage

I_F = 100 mA	V_F	<	1.0	V
I_F = 100 mA; T_j = 100 ^oC	V_F	<	0.92	V
I_F = 250 mA	V_F	<	1.35	V

Reverse current

V_R = 150 V	I_R	<	200	nA
V_R = 150 V; T_j = 100 ^oC	I_R	<	10	μA

Diode capacitance (see also page 7)

V_R = 0; f = 1 MHz	C_d	<	20	pF

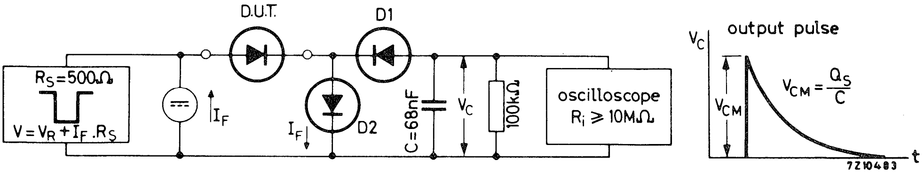
[1]) For sinusoidal operation see page 5.
For pulse operation see page 6.

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

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s typ. 1 nC

Test circuit:



D1 = D2 = BAW62

Reverse pulse: Rise time t_r = 15 ns

Pulse duration t_p = 35 μs

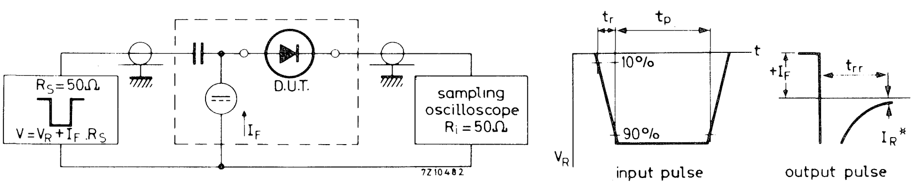
Frequency f = 25 kHz

Circuit capacitance C < 30 pF (C = Oscillope + parasitical capacitance)

Reverse recovery time when switched from

I_F = 30 mA to V_R = 3 V; R_L = 100 Ω
measured at I_R = 3 mA t_{rr} < 300 ns

Test circuit:



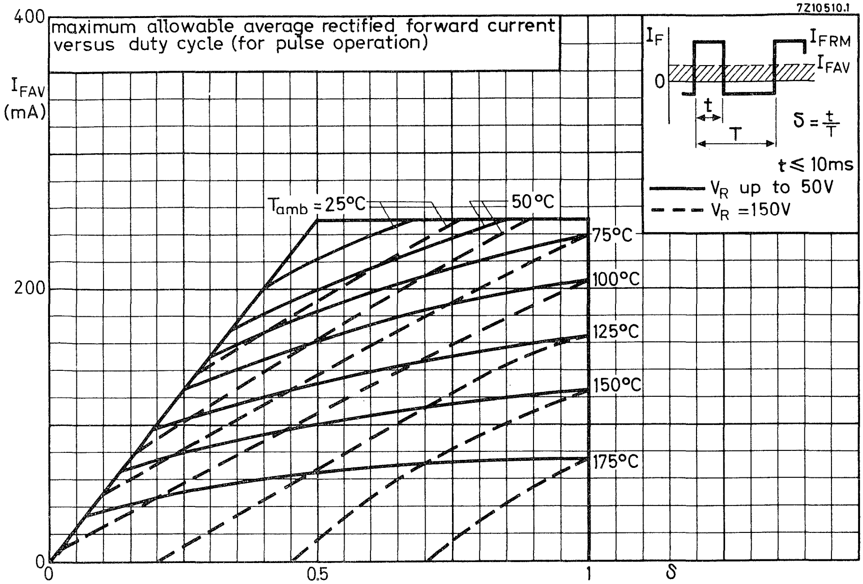
*) I_R = 3 mA

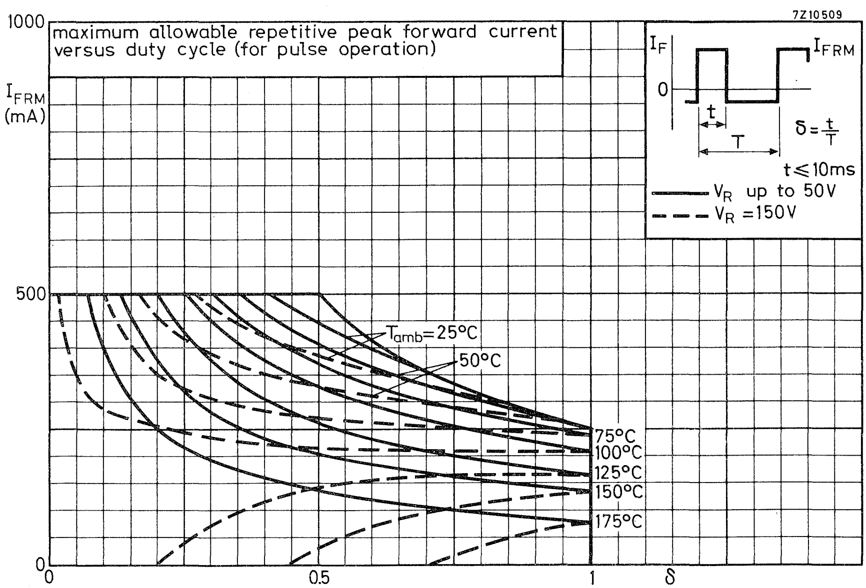
Reverse pulse: Rise time t_r = 0.6 ns   Oscilloscope:

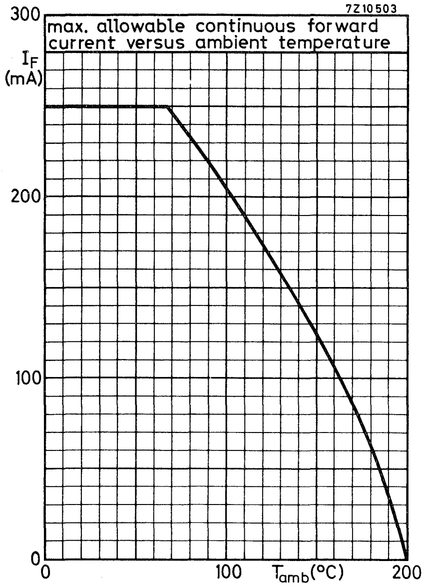
Pulse duration t_p = 100 ns   Rise time t_r = 0.35 ns

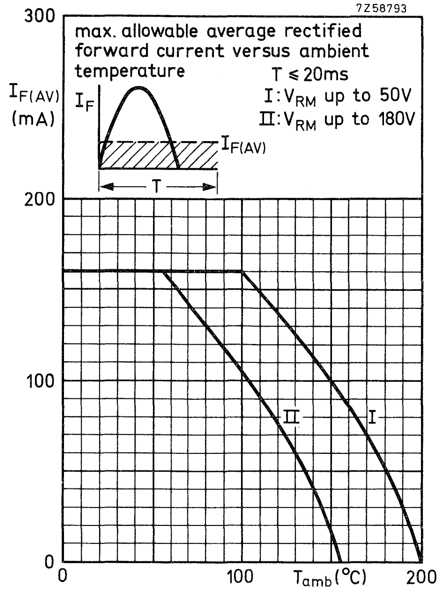
Duty cycle δ = 0.05

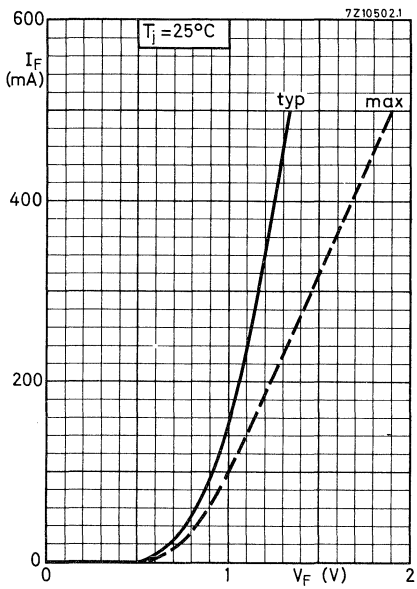
Circuit capacitance C ≤ 1 pF (C = Oscilloscope + parasitical capacitance)

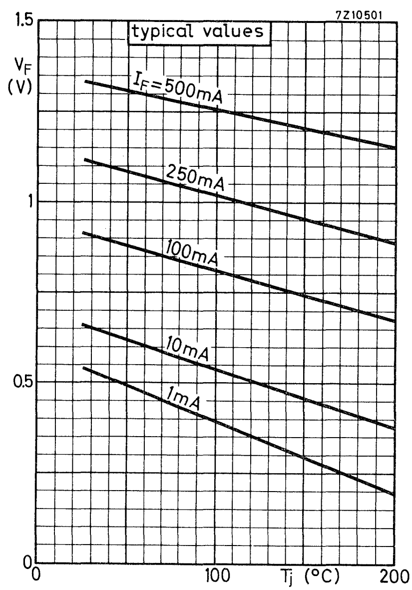

7Z10510.1
400
200
0
I_{FAV}
(mA)
maximum allowable average rectified forward current versus duty cycle (for pulse operation)
T_{amb} = 25°C
50°C
75°C
100°C
125°C
150°C
175°C
0
0.5
1
δ
I_F
I_{FRM}
I_{FAV}
0
t
T
δ = t/T
t ≤ 10ms
V_R up to 50V
V_R = 150V

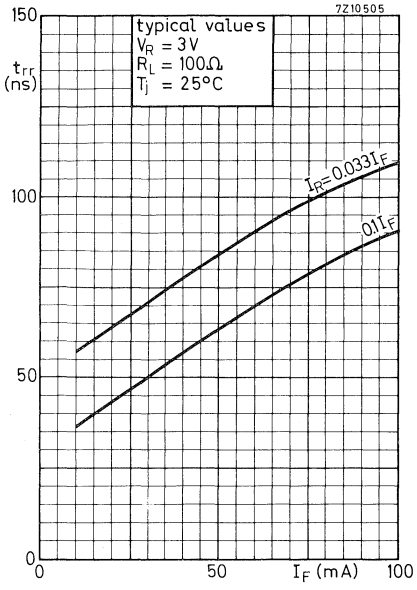

7Z10509
1000
500
0
I_{FRM}
(mA)
maximum allowable repetitive peak forward current versus duty cycle (for pulse operation)
T_{amb} = 25°C
50°C
75°C
100°C
125°C
150°C
175°C
0
0.5
1
δ
I_F
I_{FRM}
0
t
T
δ = t/T
t ≤ 10ms
V_R up to 50V
V_R = 150V

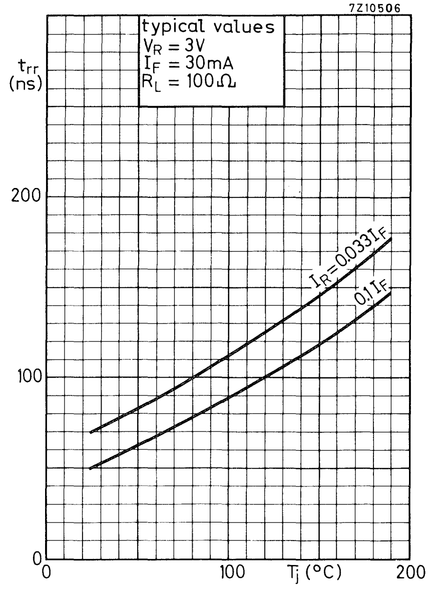

7Z10503
max. allowable continuous forward current versus ambient temperature
300
I_F (mA)
200
100
0
0
100
T_{amb} (°C)
200

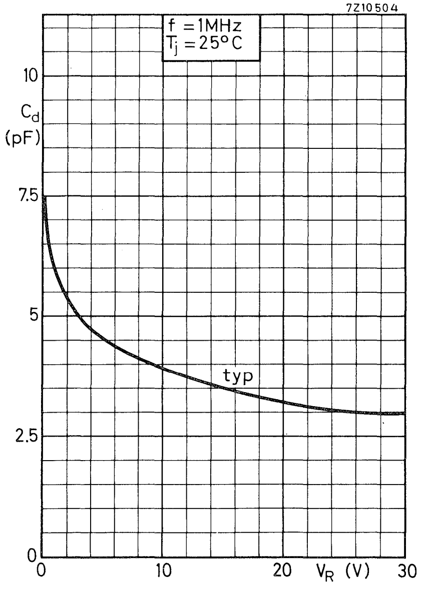

7Z58793
max. allowable average rectified forward current versus ambient temperature
T ≤ 20ms
I: V_{RM} up to 50V
II: V_{RM} up to 180V
I_F
$I_{F(AV)}$
T
300
$I_{F(AV)}$ (mA)
200
100
0
0
100
T_{amb} (°C)
200
II
I

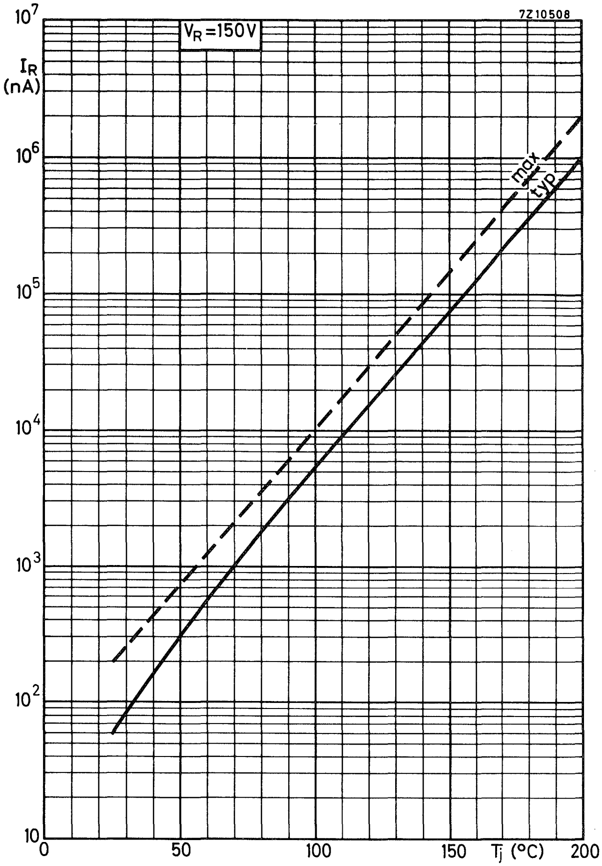

7Z10502.1
T_j = 25°C
600
I_F (mA)
400
200
0
0
1
V_F (V)
2
typ
max


7Z10501
typical values
1.5
V_F (V)
1
0.5
0
0
100
T_j (°C)
200
I_F = 500mA
250mA
100mA
10mA
1mA


7Z10505
typical values
V_R = 3 V
R_L = 100Ω
T_j = 25°C
t_{rr} (ns)
150
100
50
0
I_R=0.033I_F
0.1I_F
0
50
I_F (mA)
100


7Z10506
typical values
V_R = 3V
I_F = 30mA
R_L = 100Ω
t_{rr} (ns)
200
100
0
I_R=0.033I_F
0.1I_F
0
100
T_j (°C)
200


7Z10504
f = 1MHz
T_j = 25°C
C_d (pF)
10
7.5
5
2.5
0
typ
0
10
20
V_R (V)
30


7Z10508
$V_R = 150V$
I_R (nA)
10^7
10^6
10^5
10^4
10^3
10^2
10
0
50
100
150
T_j (°C)
200
max
typ

SILICON OXIDE PASSIVATED DIODE

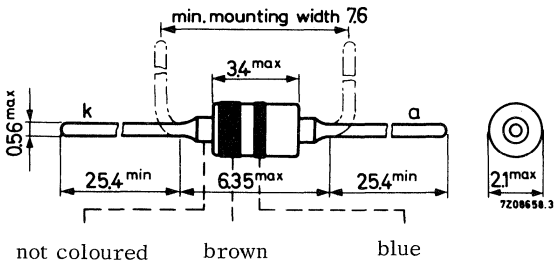
Whiskerless diffused diode in a molybdenum hard glass subminature envelope.
The BAX16 is primarily intended for general purpose industrial applications.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	150	V
Repetitive peak forward current	I_{FRM}	max.	300	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.40	$^oC/mW$
Forward voltage at I_F = 100 mA	V_F	<	1.3	V
Reverse recovery time when switched from I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	120	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	<	0.7	nC

MECHANICAL DATA

Dimensions in mm



RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage	V_R	max.	150	V [2]
Repetitive peak reverse voltage	V_{RRM}	max.	150	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	200	mA [3]
Forward current (d.c.)	I_F	max.	200	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	2500	mA
$t = 1\ s$	I_{FSM}	max.	500	mA

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.40	°C/mW

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

Forward voltage

$I_F = 1$ mA	V_F	<	0.65	V
$I_F = 10$ mA; $T_j = 100\ ^{\circ}C$	V_F	<	0.85	V
$I_F = 100$ mA	V_F	<	1.3	V [4]
$I_F = 200$ mA	V_F	<	1.5	V [4]
$I_F = 200$ mA; $T_j = 175\ ^{\circ}C$	V_F	<	1.4	V [4]

Reverse current

$V_R = 50$ V	I_R	<	25	nA
$V_R = 50$ V; $T_j = 150\ ^{\circ}C$	I_R	<	25	μA
$V_R = 150$ V	I_R	<	100	nA
$V_R = 150$ V; $T_j = 150\ ^{\circ}C$	I_R	<	100	μA

Diode capacitance (see also page 5)

$V_R = 0$; f = 1 MHz	C_d	<	10	pF

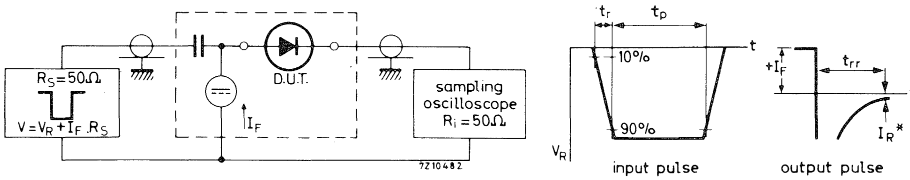
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.
2) Measured at zero lifetime at $I_R = 10\ \mu A$: $V_R > 165$ V.
3) For sinusoidal operation see page 5. For pulse operation see page 4.
4) Measured under pulsed conditions to prevent excessive dissipation.

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

Reverse recovery time when switched from

I_F = 30 mA to V_R = 3 V; R_L = 100 Ω
(see also page 6) measured at I_R = 1 mA t_{rr} typ. 70 ns
< 120 ns

Test circuit:



*) I_R = 1 mA

Reverse pulse: Rise time t_r = 0.6 ns Oscilloscope:

Pulse duration t_p = 100 ns Rise time t_r = 0.35 ns

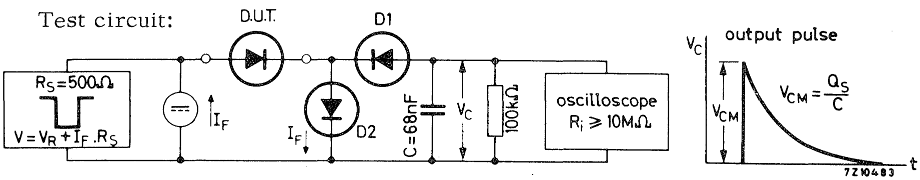
Duty cycle δ = 0.05

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

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s < 0.7 nC

Test circuit:



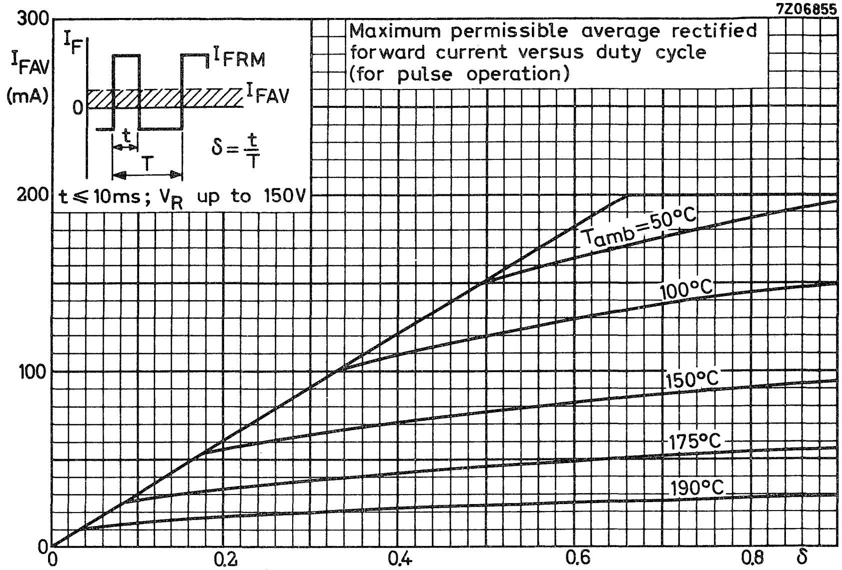
D1 = D2 = BAW62

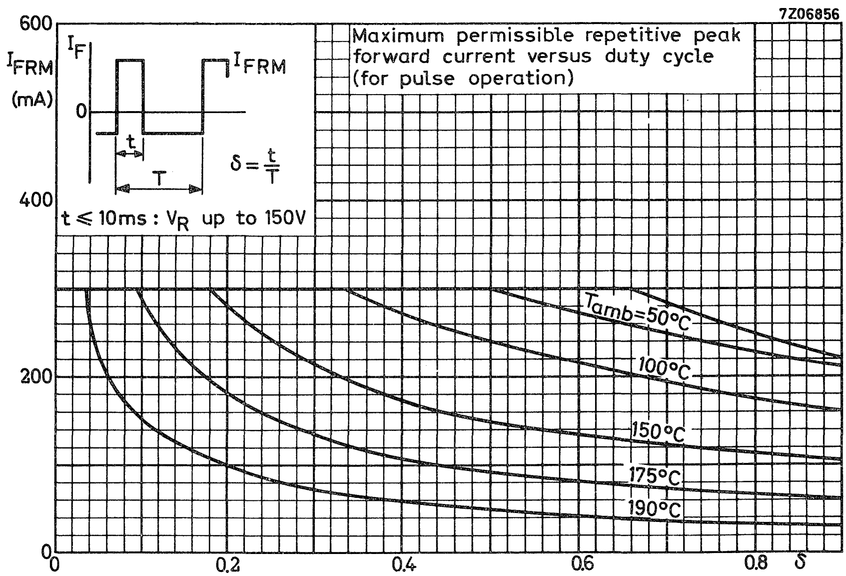
Reverse pulse: Rise time t_r = 15 ns

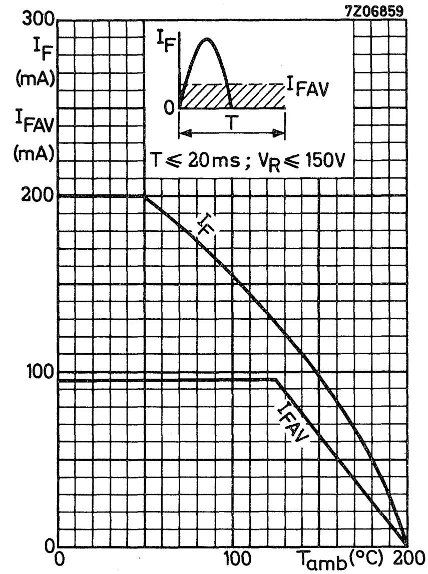
Pulse duration t_p = 35 μs

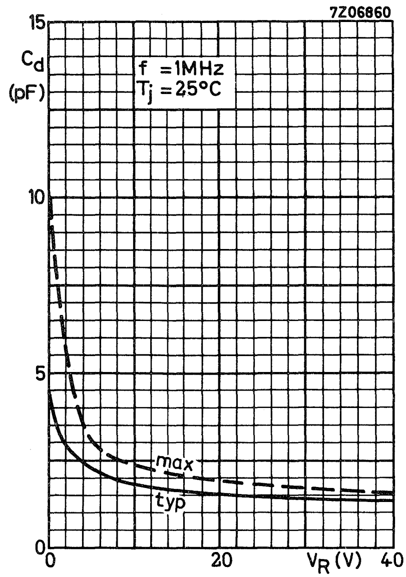
Frequency f = 25 kHz

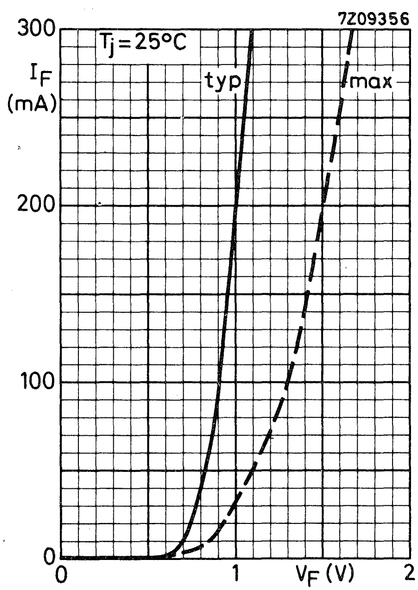
Circuit capacitance C < 30 pF (C = Oscilloscope + parasitical capacitance)

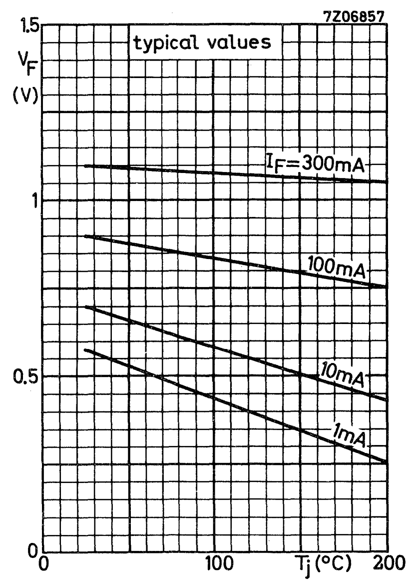

7Z06855
Maximum permissible average rectified forward current versus duty cycle (for pulse operation)
I_{FAV} (mA)
I_F
I_{FRM}
I_{FAV}
$\delta = \frac{t}{T}$
$t \leqslant 10$ms; V_R up to 150V
T_{amb}=50°C
100°C
150°C
175°C
190°C
300
200
100
0
0
0.2
0.4
0.6
0.8
δ

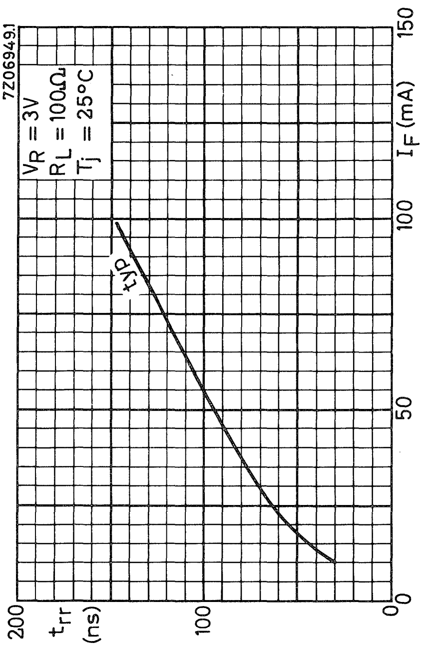

7Z06856
Maximum permissible repetitive peak forward current versus duty cycle (for pulse operation)
I_{FRM} (mA)
I_F
I_{FRM}
$\delta = \frac{t}{T}$
$t \leqslant 10$ms : V_R up to 150V
T_{amb}=50°C
100°C
150°C
175°C
190°C
600
400
200
0
0
0.2
0.4
0.6
0.8
δ

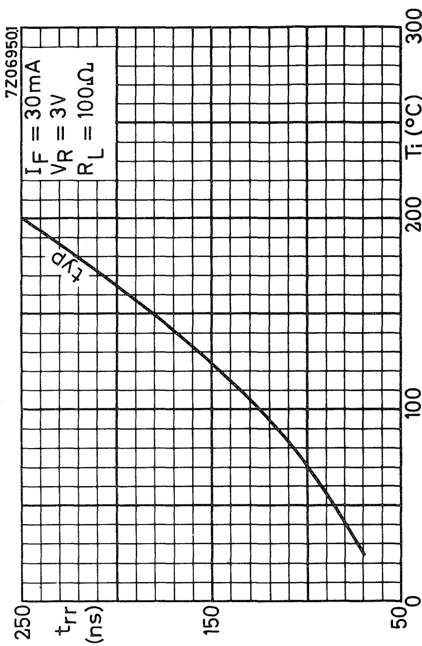

7Z06859
300
I_F
(mA)
I_{FAV}
(mA)
200
100
0
0
100
T_{amb} (°C)
200
I_F
I_{FAV}
0
T
$T \leqslant 20$ ms ; $V_R \leqslant 150$ V
I_F
I_{FAV}

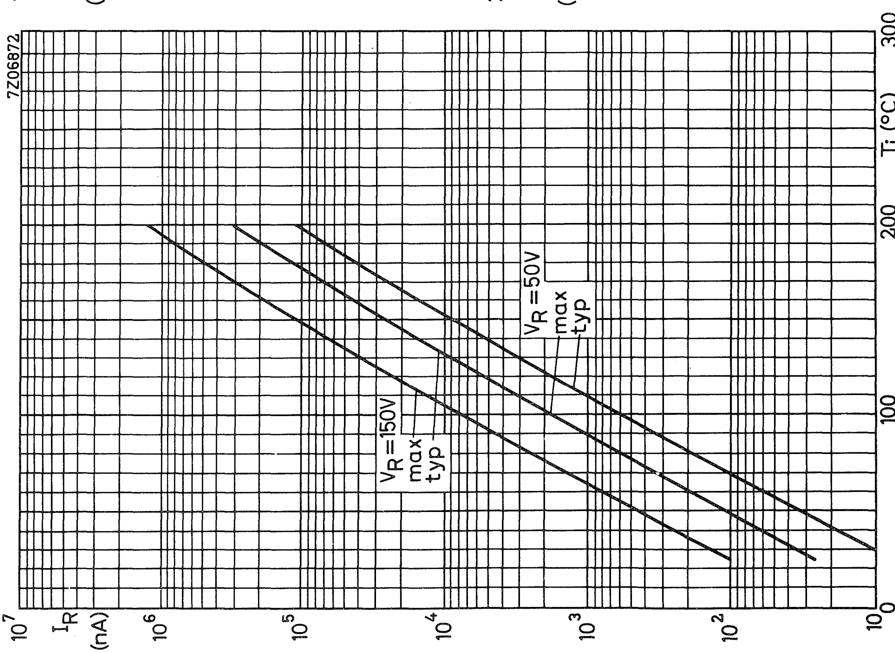

7Z06860
15
C_d
(pF)
10
5
0
0
20
V_R (V)
40
f = 1MHz
T_j = 25°C
max
typ


7Z09356
300
I_F
(mA)
200
100
0
0
1
V_F (V)
2
T_j = 25°C
typ
max


7Z06857
1.5
V_F
(V)
1
0.5
0
0
100
T_j (°C)
200
typical values
I_F = 300mA
100mA
10mA
1mA


7Z06949.1
V_R = 3V
R_L = 100Ω
T_j = 25°C
typ
t_rr (ns)
I_F (mA)
200
100
0
0
50
100
150


7Z06950.1
I_F = 30mA
V_R = 3V
R_L = 100Ω
typ
t_rr (ns)
T_j (°C)
250
150
50
0
100
200
300

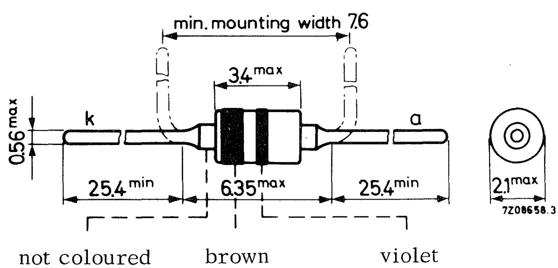

7Z06872
I_R (nA)
T_j (°C)
V_R = 150V
max
typ
V_R = 50V
max
typ
10^7
10^6
10^5
10^4
10^3
10^2
10
0
100
200
300

SILICON OXIDE PASSIVATED DIODE

Whiskerless diffused diode in a molybdenum hard glass subminiature envelope. The BAX17 is primarily intended for general purpose industrial applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	200	V
Repetitive peak forward current	I_{FRM}	max.	300	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.40	$^oC/mW$
Forward voltage at I_F = 200 mA	V_F	<	1.2	V
Reverse recovery time when switched from I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	120	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	<	0.7	nC

MECHANICAL DATA Dimensions in mm



RATINGS (Limiting values) [1])

Voltages

Continuous reverse voltage	V_R	max.	200	V [2])
Repetitive peak reverse voltage	V_{RRM}	max.	200	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	200	mA [3])
Forward current (d.c.)	I_F	max.	200	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	2500	mA
$t = 1$ s	I_{FSM}	max.	500	mA

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.40	°C/mW

CHARACTERISTICS $T_j = 25$ °C unless otherwise specified

Forward voltage

$I_F = 1$ mA	V_F	<	0.65	V
$I_F = 10$ mA; $T_j = 100$ °C	V_F	<	0.75	V
$I_F = 100$ mA	V_F	<	1.1	V [4])
$I_F = 200$ mA	V_F	<	1.2	V [4])
$I_F = 200$ mA; $T_j = 175$ °C	V_F	<	1.2	V [4])

Reverse current

$V_R = 50$ V	I_R	<	25	nA
$V_R = 50$ V; $T_j = 150$ °C	I_R	<	25	μA
$V_R = 150$ V	I_R	<	100	nA
$V_R = 200$ V; $T_j = 150$ °C	I_R	<	100	μA

Diode capacitance (see also page 5)

$V_R = 0$; $f = 1$ MHz	C_d	<	10	pF

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.
2) Measured at zero lifetime at $I_R = 10\ \mu A$: $V_R \geq 220$ V.
3) For sinusoidal operation see page 5. For pulse operation see page 4.
4) Measured under pulsed conditions to prevent excessive dissipation.

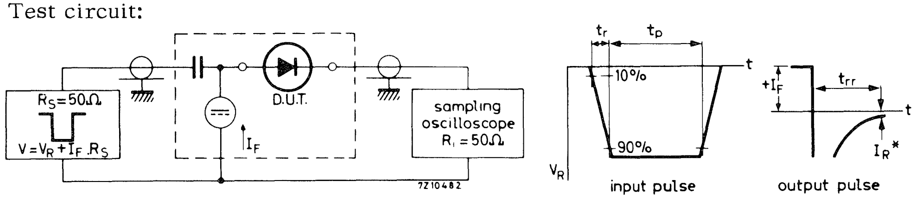
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Reverse recovery time when switched from

I_F = 30 mA to V_R = 3 V; R_L = 100 Ω
(see also page 6) measured at I_R = 1 mA

t_{rr}	typ.	70	ns
	<	120	ns

Test circuit:



*) I_R = 1 mA

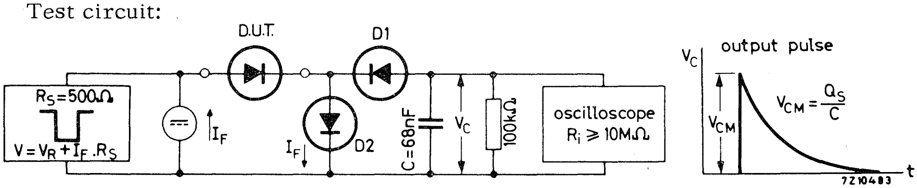
Reverse pulse:	Rise time	t_r = 0.6 ns		Oscilloscope:		
	Pulse duration	t_p = 100 ns		Rise time	t_r = 0.35 ns	
	Duty cycle	δ = 0.05				

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

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s < 0.7 nC

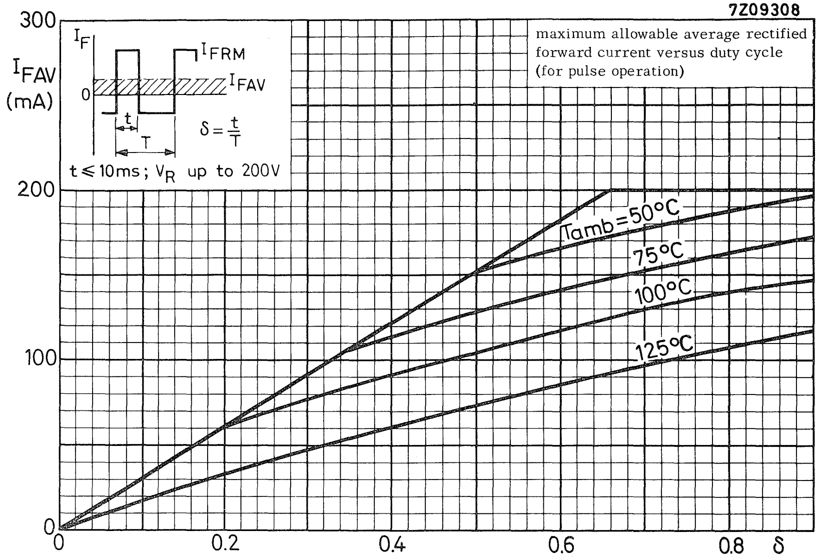
Test circuit:

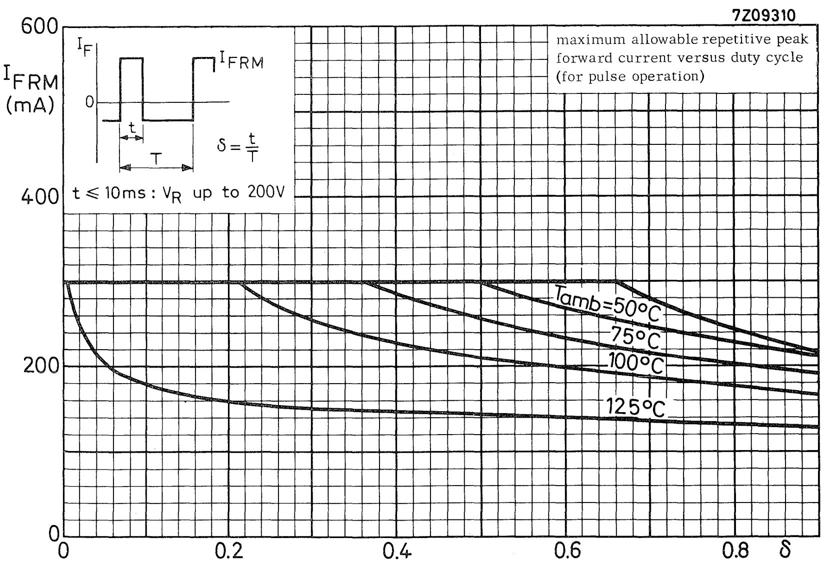


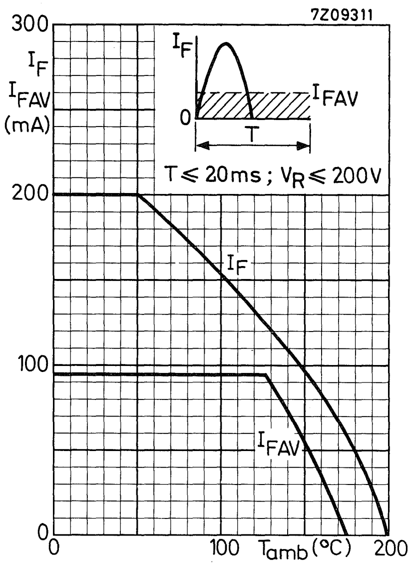
D1 = D2 = BAW62

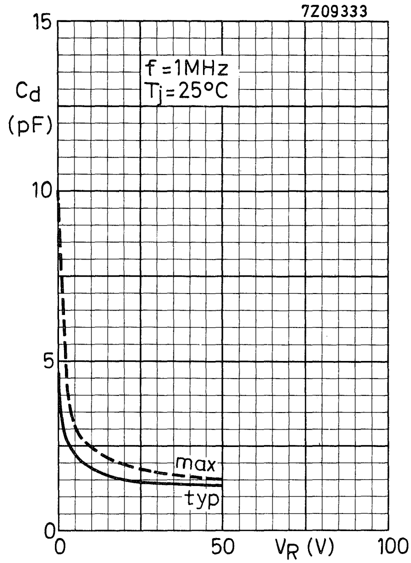
Reverse pulse:	Rise time	t_r = 15 ns
	Pulse duration	t_p = 35 μs
	Frequency	f = 25 kHz

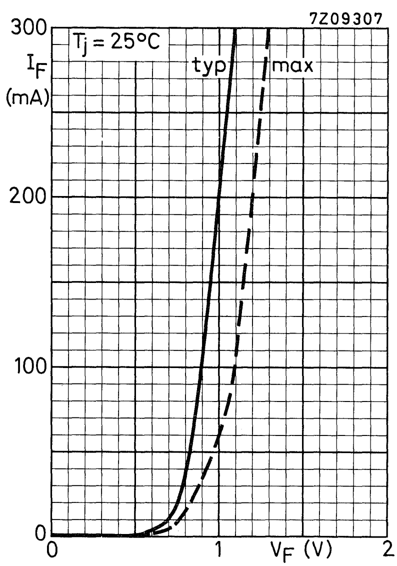
Circuit capacitance C < 30 pF (C = Oscilloscope + parasitical capacitance)

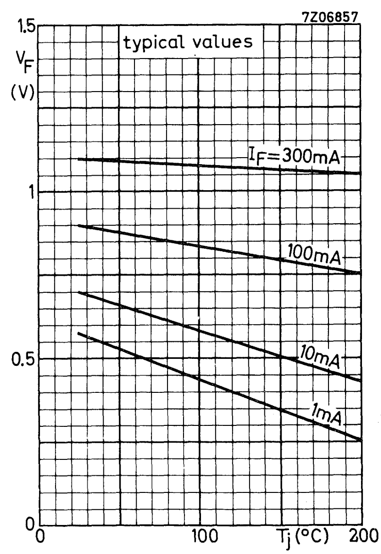

7Z09308
maximum allowable average rectified forward current versus duty cycle (for pulse operation)
I_F
I_{FRM}
I_{FAV}
0
t
T
$\delta = \frac{t}{T}$
t ≤ 10ms; V_R up to 200V
300
200
100
0
I_{FAV} (mA)
0.2
0.4
0.6
0.8
δ
Tamb=50°C
75°C
100°C
125°C

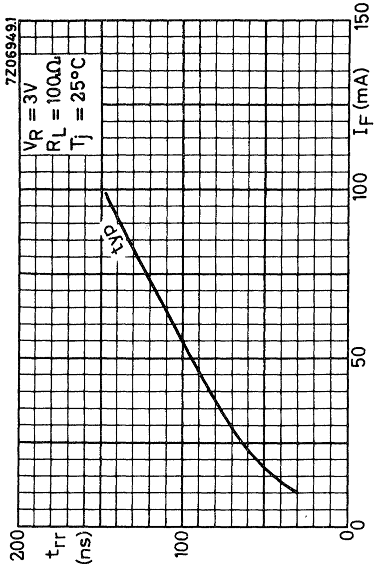

7Z09310
maximum allowable repetitive peak forward current versus duty cycle (for pulse operation)
I_F
I_{FRM}
0
t
T
$\delta = \frac{t}{T}$
t ≤ 10ms : V_R up to 200V
600
400
200
0
I_{FRM} (mA)
0.2
0.4
0.6
0.8
δ
Tamb=50°C
75°C
100°C
125°C

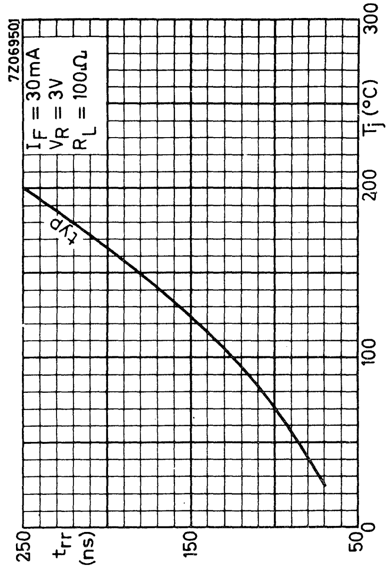

7Z09311
300
I_F
I_{FAV}
(mA)
I_F
I_{FAV}
0
T
T ≤ 20ms ; V_R ≤ 200V
200
I_F
100
I_{FAV}
0
0
100
T_{amb} (°C)
200

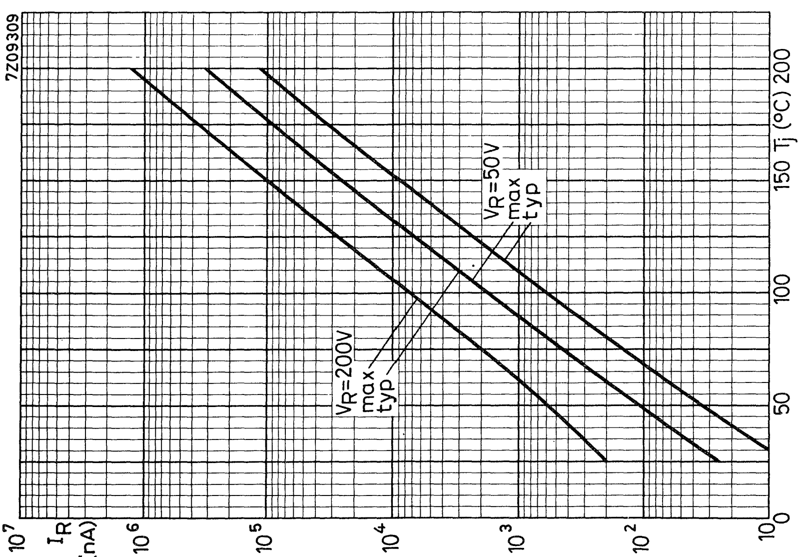

7Z09333
15
f = 1MHz
T_j = 25°C
C_d
(pF)
10
5
max
typ
0
0
50
V_R (V)
100


7Z09307
300
T_j = 25°C
I_F
(mA)
typ
max
200
100
0
0
1
V_F (V)
2


7Z06857
1.5
typical values
V_F
(V)
I_F=300mA
1
100mA
0.5
10mA
1mA
0
0
100
T_j (°C)
200


7Z06949.1
$V_R = 3V$
$R_L = 100\Omega$
$T_j = 25°C$
typ
t_{rr} (ns)
I_F (mA)
0
50
100
150
200


7Z06950.1
$I_F = 30mA$
$V_R = 3V$
$R_L = 100\Omega$
typ
t_{rr} (ns)
T_j (°C)
0
50
100
150
200
250
300


7Z09309
V_R=200V
max
typ
V_R=50V
max
typ
I_R (nA)
T_j (°C)
10^7
10^6
10^5
10^4
10^3
10^2
10
0
50
100
150
200

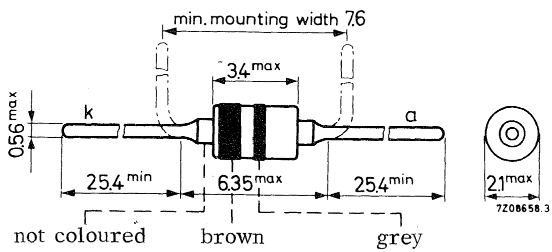
SILICON OXIDE PASSIVATED DIODE

Whiskerless diffused diode in a molybdenum hard glass subminiature envelope.
The BAX18 is a general purpose diode primarily intended for rectifier applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	V
Average forward current	I_{FAV}	max.	350	mA
Junction temperature	T_j	max.	200	^oC
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.3	$^oC/mW$

MECHANICAL DATA

Dimensions in mm



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

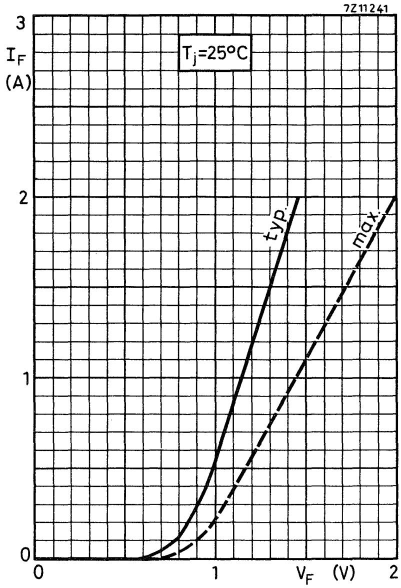
Voltages				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	V
Currents				
Average rectified forward current (see page 5)	I_{FAV}	max.	350	mA
Forward current (d.c.)	I_F	max.	500	mA
Repetitive peak forward current	I_{FRM}	max.	2.0	A
Non repetitive peak forward current t = 10 ms; half sine wave	I_{FSM}	max.	6.0	A
Temperatures				
Storage temperature	T_{stg}		-65 to +200	^{o}C
Junction temperature	T_j	max.	200	^{o}C

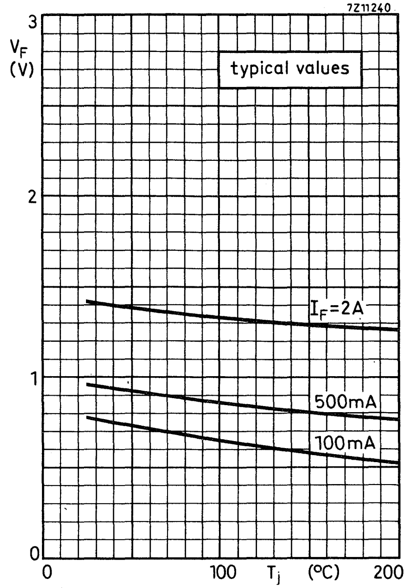
THERMAL RESISTANCE

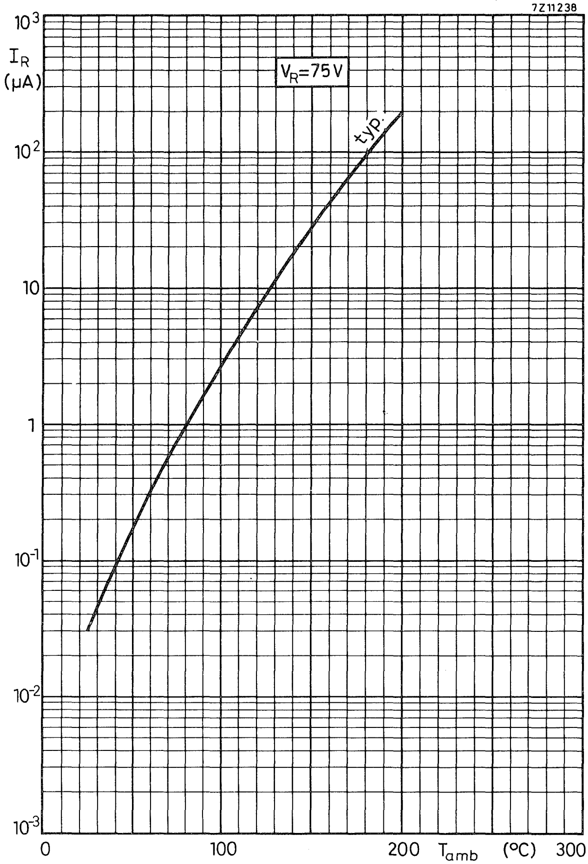
From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a}$	=	0.3	$^{o}C/mW$

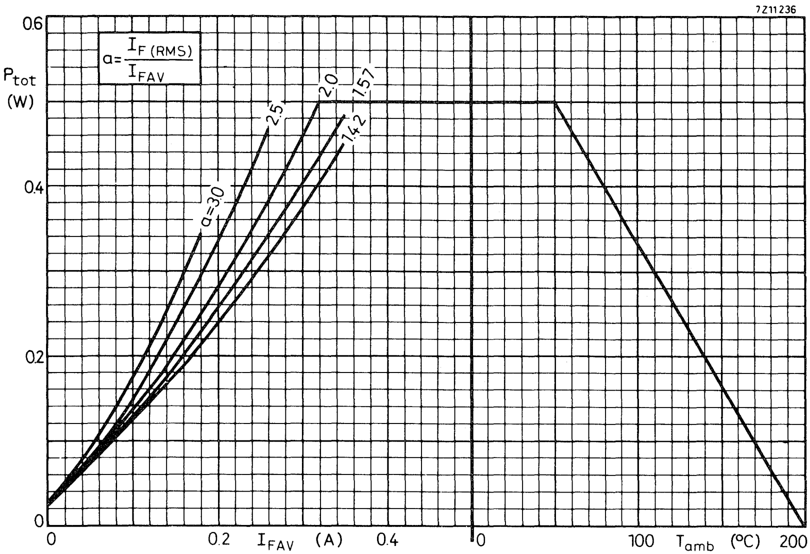
CHARACTERISTICS T_j = 25 ^{o}C unless otherwise specified

Forward voltage				
I_F = 2 A; T_j = 150 ^{o}C	V_F	<	2.0	V
Reverse current				
V_R = 75 V; T_j = 150 ^{o}C	I_R	<	100	μA


7Z11241
3
2
1
0
I_F
(A)
T_j=25°C
typ.
max.
0
1
2
V_F (V)


7Z11240
3
2
1
0
V_F
(V)
typical values
I_F=2A
500mA
100mA
0
100
200
T_j (°C)


7Z11238
I_R (μA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
$V_R = 75\,V$
typ.
0
100
200
T_{amb} (°C)
300



From the left hand 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 $n\omega R_L C_L$ and $\frac{R_t + R_{diff}}{nR_L}$ and can be found from existing graphs.

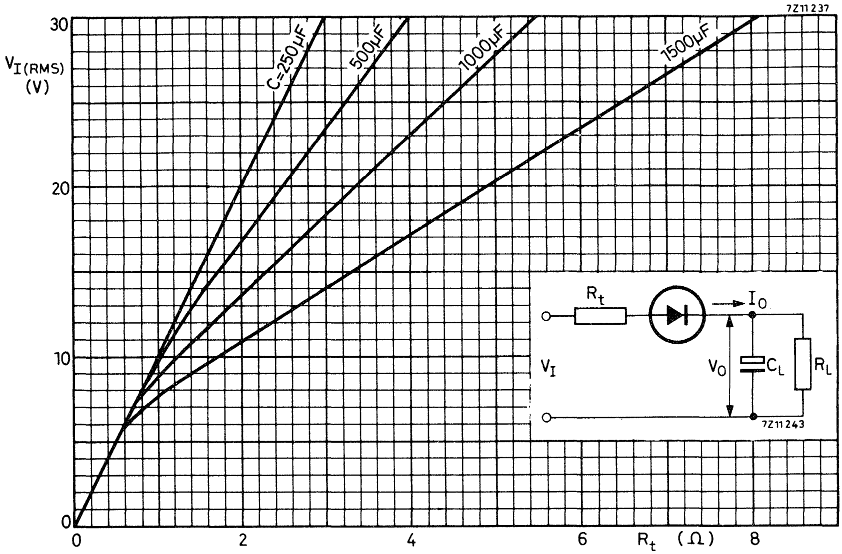
See Application Book: RECTIFIER DIODES.

Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

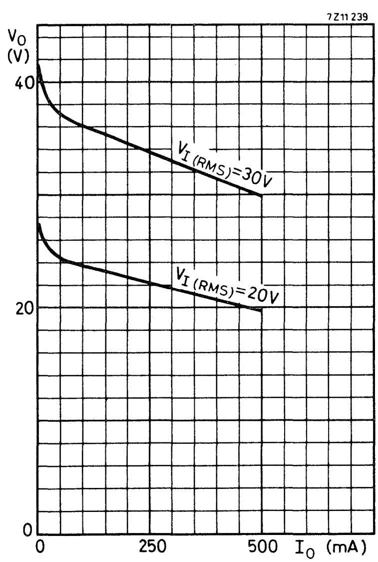
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph on page 6.

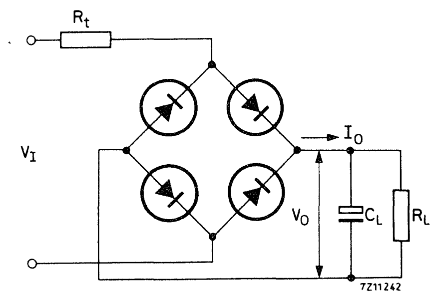
R_{diff} can be found from the left hand graph on the upper half of page 3.

Required minimum value of R_t
R_t includes the transformer resistance



V_O, I_O characteristics for the circuit shown





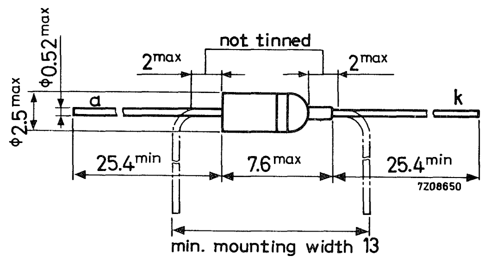
V_I	R_t	C_L
30 V	5.6 Ω	1000 µF
20 V	3.4 Ω	1000 µF

SILICON PLANAR EPITAXIAL DIODE

Silicon planar epitaxial diode in subminiature all glass DO-7 envelope.
The BAX78 is a diode, for very high speed high current applications, primarily intended for core gating in very fast memories.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

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

Voltages

Continuous reverse voltage	V_R	max.	55	V [1]
Repetitive peak reverse voltage	V_{RRM}	max.	55	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	300	mA
Forward current (d.c.)	I_F	max.	300	mA
Repetitive peak forward current	I_{FRM}	max.	600	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	2000	mA
$t = 1$ s	I_{FSM}	max.	600	mA

Temperatures

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

[1]) Measured at zero lifetime: $I_R = 5\ \mu A$; $V_R > 65$ V

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 = 1 mA	V_F		0.55 to 0.65	V
I_F = 10 mA	V_F		0.65 to 0.75	V
I_F = 100 mA	V_F		0.85 to 0.95	V
I_F = 500 mA[1]	V_F		1.00 to 1.25	V
Reverse current				
V_R = 55 V	I_R	<	100	nA
V_R = 55 V; T_j = 150 °C	I_R	<	100	μA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	2	pF
Forward recovery voltage				
I_F = 400 mA; t_r = 30 ns	V_{FM}	<	2.0	V
I_F = 400 mA; t_r = 100 ns	V_{FM}	<	1.5	V
Recovered charge when switched from				
I_F = 10 mA to V_R = 5 V; R_L = 500 Ω	Q_s	<	35	pC
Reverse recovery time when switched from				
I_F = 400 mA to V_R = 40 V; R_L = 1 kΩ measured at I_R = 4 mA	t_{rr}	<	20	ns

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FOR NEW DESIGN THE SUCCESSOR
TYPE BAV10 IS RECOMMENDED

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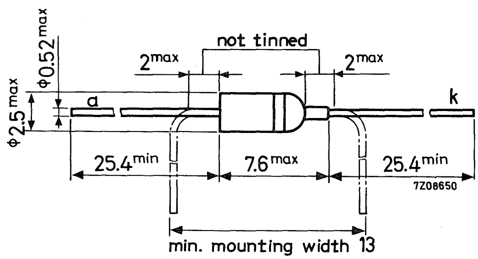
1) Measured under pulsed conditions to avoid excessive dissipation.

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.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode side

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

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
Forward current (d.c.)	I_F	max.	115	mA
Repetitive peak forward current	I_{FRM}	max.	225	mA
Non repetitive peak forward current $t = 1\ \mu s$	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	$R_{th\ j\text{-}a}$	=	0.4	$^{o}C/mW$

CHARACTERISTICS

T_j = 25 ^{o}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 ^{o}C	I_R	<	50	μA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	2	pF
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
Recovered charge when switched from				
I_F = 10 mA to V_R = 5 V; R_L = 500 Ω	Q_s	<	35	pC
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

---

FOR NEW DESIGN THE SUCCESSOR
TYPE BAW62 IS RECOMMENDED

GERMANIUM GOLD BONDED DIODE

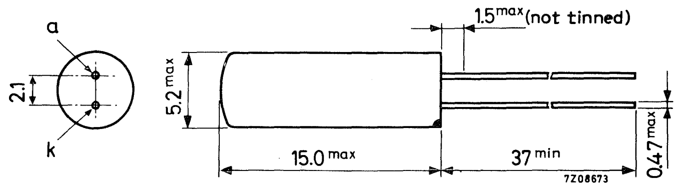
Germanium gold bonded diode in single ended all glass construction.

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

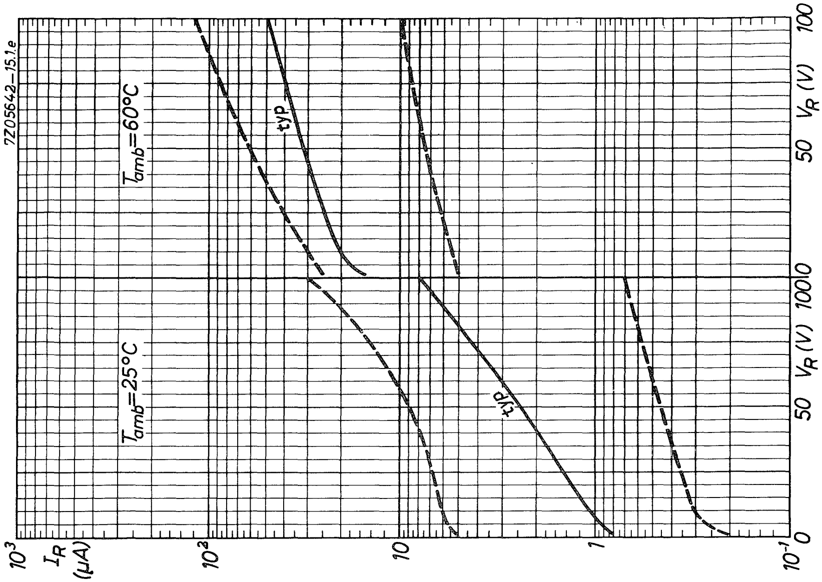
		T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	0.10 to 0.25	0.03 to 0.20	V
I_F = 10 mA	V_F	0.25 to 0.55	0.20 to 0.50	V
I_F = 200 mA	V_F	0.50 to 1.0	0.48 to 1.0	V
I_F = 300 mA	V_F	0.55 to 1.25	0.55 to 1.25	V
Reverse current				
V_R = 1.5 V	I_R	0.2 to 5	5 to 26	μA
V_R = 10 V	I_R	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

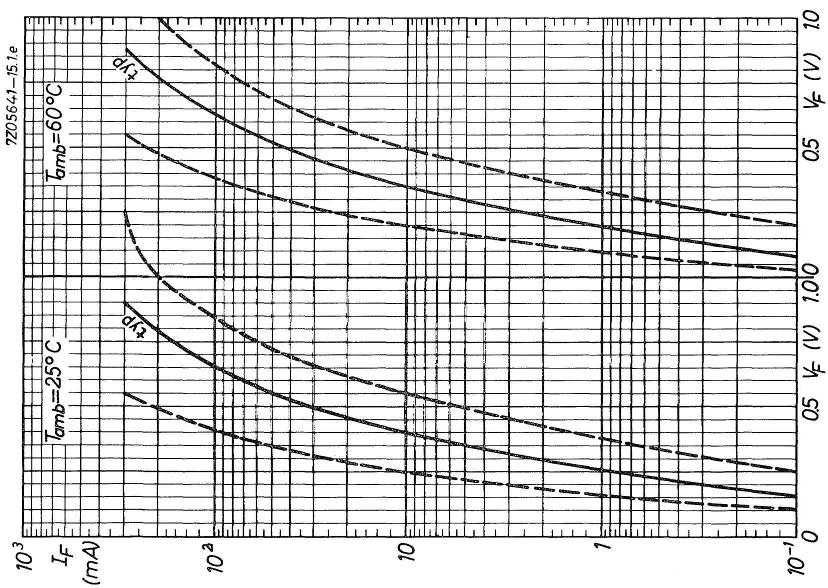
MECHANICAL DATA Dimensions in mm



The red dot indicates the cathode

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


7Z05642-15.1.e
$T_{amb}=60°C$
$T_{amb}=25°C$
typ
typ
10^3
I_R
(μA)
10^2
10
1
10^{-1}
0
50
100
V_R (V)


7Z05641-15.1.e
$T_{amb}=60°C$
$T_{amb}=25°C$
typ
typ
10^3
I_F
(mA)
10^2
10
1
10^{-1}
0
0.5
1.0
V_F (V)

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

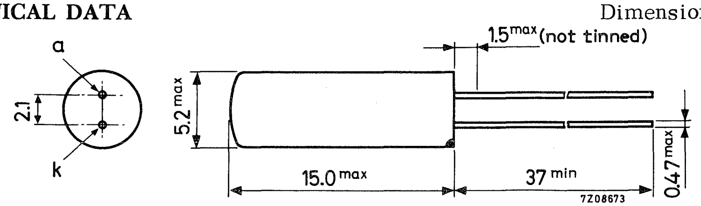
			T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage	I_F = 0.1 mA	V_F	0.12 to 0.26	0.06 to 0.19	V
	I_F = 10 mA	V_F	0.30 to 0.48	0.14 to 0.28	V
	I_F = 50 mA	V_F	0.40 to 0.78	0.37 to 0.75	V
	I_F = 250 mA	V_F	< 1.65		V
Reverse current	V_R = 1.5 V	I_R	typ. 0.4	< 20	µA
	V_R = 10 V	I_R	typ. 1.5	< 30	µA
	V_R = 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

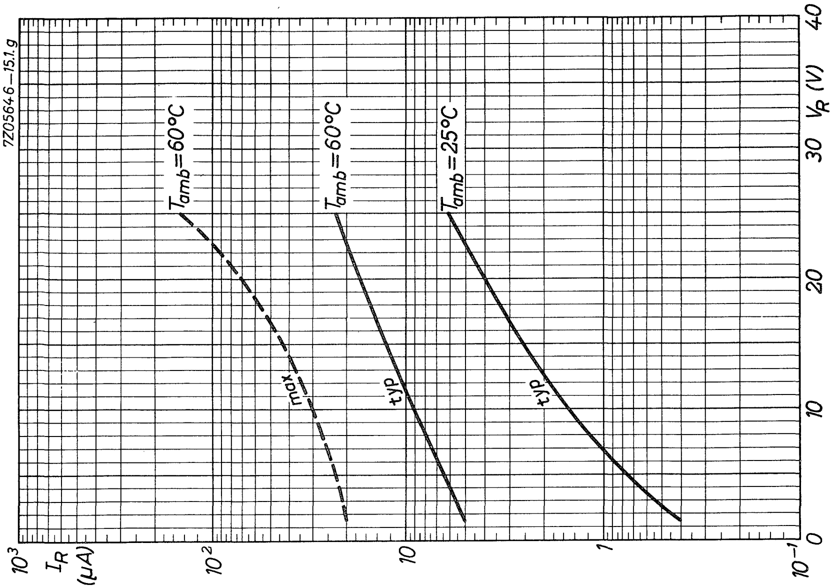
I_R	typ.	140	µA
	<	250	µA

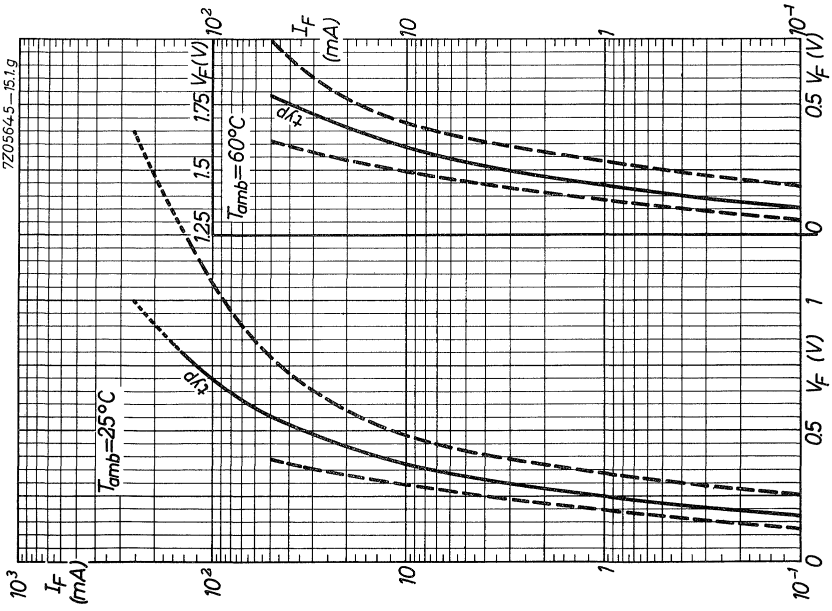
MECHANICAL DATA

Dimensions in mm



The red dot indicates the cathode


7Z05646—15.1.g
T_{amb}=60°C
T_{amb}=60°C
T_{amb}=25°C
max
typ
typ
V_R (V)
0
10
20
30
40
I_R (μA)
10^3
10^2
10
1
10^{-1}


7Z05645—15.1.g
T_{amb}=60°C
T_{amb}=25°C
typ
typ
V_F (V)
1.25
1.5
1.75
I_F (mA)
V_F (V)
0
0.5
1
I_F (mA)
10^3
10^2
10
1
10^{-1}

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 °C	I_{FAV}	max.	160	mA
T_{amb} = 75 °C	I_{FAV}	max.	70	mA
Forward current (d.c.) T_{amb} = 25 °C	I_F	max.	270	mA
T_{amb} = 75 °C	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	°C
Storage temperature	T_{stg}		−55 to +90	°C

THERMAL RESISTANCE

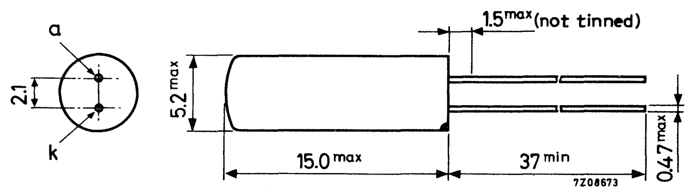
From junction to ambient $R_{th\ j\text{-}a}$ = 0.35 °C/mW

CHARACTERISTICS

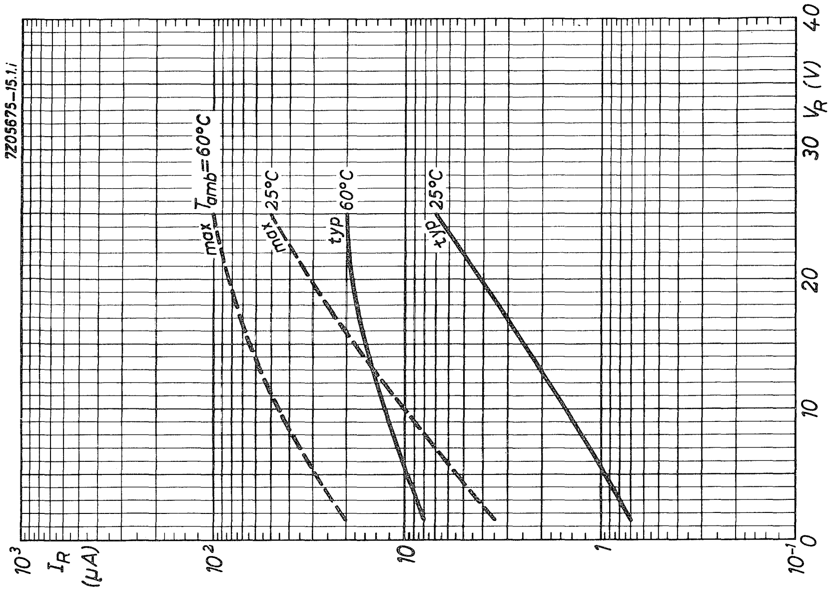
			T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage	I_F = 0.1 mA	V_F	< 0.21	< 0.15	V
	I_F = 10 mA	V_F	< 0.41	< 0.35	V
	I_F = 500 mA	V_F	< 0.90		V
Reverse current	V_R = 1.5 V	I_R	< 3.5	< 20	µA
	V_R = 10 V	I_R	< 10	< 45	µA
	V_R = 25 V	I_R	< 50	< 100	µA

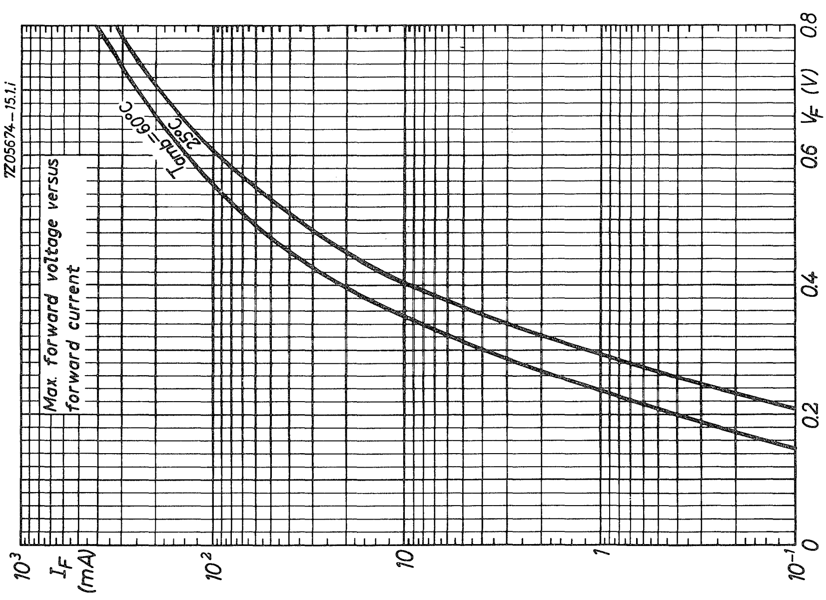
Reverse recovery current when switched
from I_F = 400 mA to V_R = 10 V; T_{amb} = 25 °C
measured at t_{rr} = 3.5 µs I_R < 150 µA

MECHANICAL DATA Dimensions in mm



The red dot indicates the cathode


7Z05675-15.1.i
max T_{amb}=60°C
max 25°C
typ 60°C
typ 25°C
10^3
I_R (μA)
10^2
10
1
10^{-1}
0
10
20
30
40
V_R (V)


7Z05674-15.1.i
Max. forward voltage versus forward current
T_{amb}=60°C
25°C
10^3
I_F (mA)
10^2
10
1
10^{-1}
0
0.2
0.4
0.6
0.8
V_F (V)

GOLD BONDED DIODE

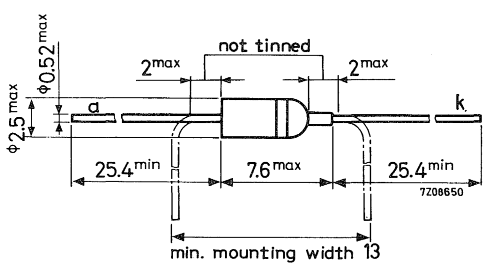
Gold bonded germanium diode in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

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	^oC
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 coloured band indicates the cathode

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	^{o}C
Junction temperature	T_j	max.	75	^{o}C

THERMAL RESISTANCE

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

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

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

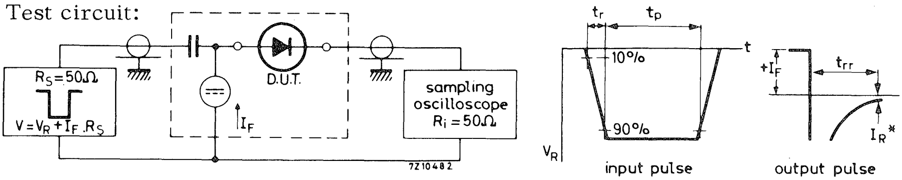
V_R = 1 V; f = 1 MHz	C_d < 3.5 pF

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:



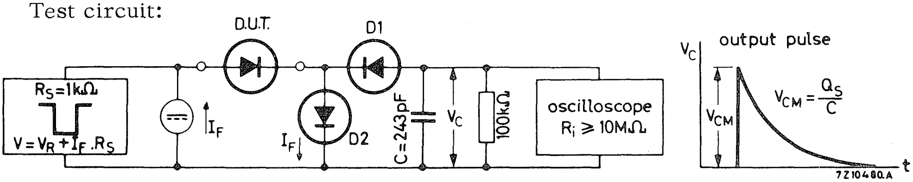
*) $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

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 < 600 pC

Test circuit:



D1 = D2 = BAW62

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

POINT CONTACT DIODE

Germanium diode in all glass construction for use in video detector circuits.

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

Voltages				
Continuous reverse voltage	V_R	max.	15	V
Repetitive peak reverse voltage	V_{RRM}	max.	22.5	V
Currents				
Forward current (d.c.)	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t \leq 1$ s)	I_{FSM}	max.	400	mA
Temperature				
Operating ambient temperature	T_{amb}		-50 to +75	°C

CHARACTERISTICS T_{amb} = 25 °C

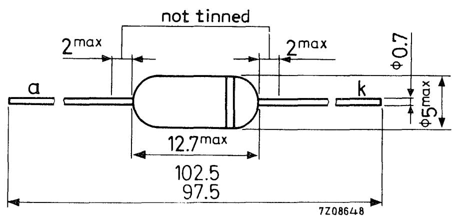
Forward voltage at I_F = 0.1 mA	V_F		0.1 to 0.25	V
Reverse current at V_R = 1.5 V	I_R		1 to 30	μA
Diode capacitance	C_d	typ.	1	pF

MECHANICAL DATA

Dimensions in mm

Net weight: 0.6 g

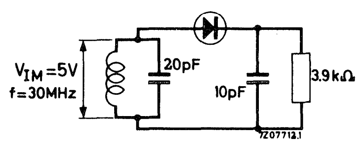
The coloured band indicates the cathode



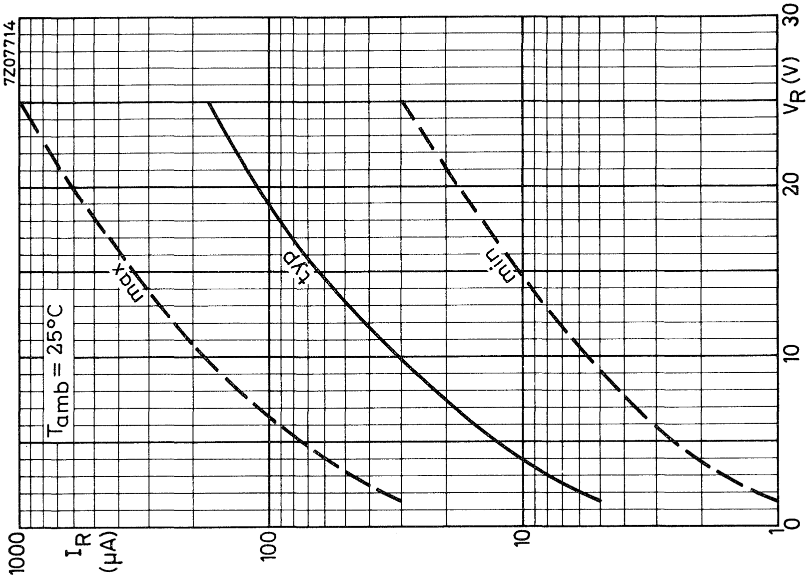
APPLICATION INFORMATION

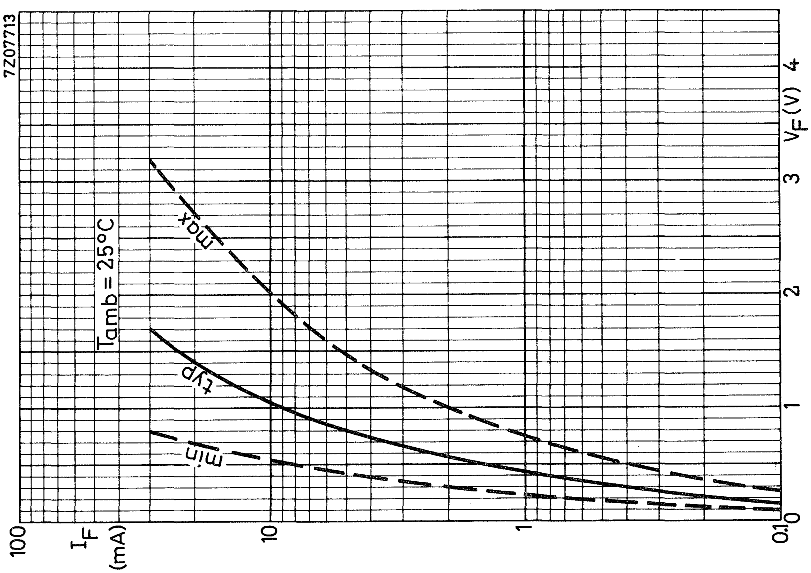
Diode in video detector circuit

Efficiency: η = 62%
Damping resistance: 3 kΩ



FOR NEW DESIGN THE SUCCESSOR TYPE OA90 IS RECOMMENDED


7Z07714
T_{amb} = 25°C
max
typ
min
I_R (μA)
V_R (V)
1000
100
10
1
0
10
20
30


7Z07713
T_{amb} = 25°C
max
typ
min
I_F (mA)
V_F (V)
100
10
1
0.1
0
1
2
3
4

POINT CONTACT DIODE

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 in accordance with the Absolute Maximum System (IEC 134)

		T_{amb} = 25 °C	60 °C	
Reverse voltage	V_R	max. 30	30	V
Peak reverse voltage	V_{RM}	max. 45	45	V
Forward current (d.c.) at $V_{RM max.}$	I_F	max. 10	4	mA
Forward current (peak value)	I_{FM}	max. 100	100	mA
Non rep. peak forward current (t = 1 s)	I_{FSM}	max. 200	200	mA

CHARACTERISTICS T_{amb} = 25 °C

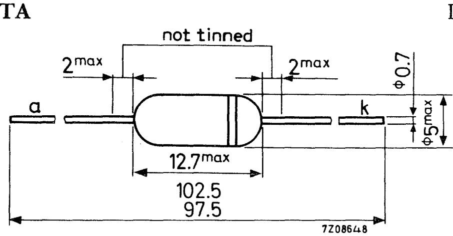
Forward voltage

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 coloured band indicates the cathode

FOR NEW DESIGN THE SUCCESSOR TYPE AA119 IS RECOMMENDED

POINT CONTACT DIODE

Germanium diode in all glass construction for use in video detector circuits.

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

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	^oC

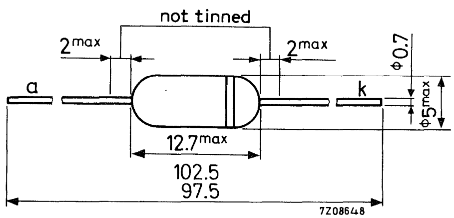
CHARACTERISTICS

Forward voltage at T_{amb} = 25 ^oC				
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 ^oC				
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 coloured band indicates the cathode side

FOR NEW DESIGN THE SUCCESSOR TYPE OA90 IS RECOMMENDED

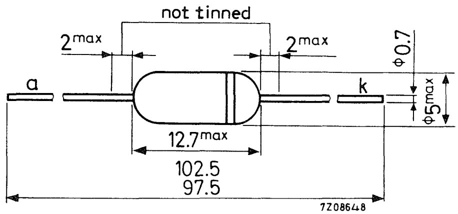
POINT CONTACT DIODE

Germanium diode in all glass construction for use in a.m. detector circuits.
Type 2-OA79 consists of 2 diodes OA79 selected for operation in a ratio detector circuit.

MECHANICAL DATA

Dimensions in mm

The coloured band indicates the cathode



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

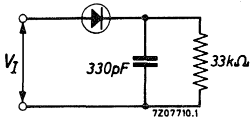
Continuous reverse voltage	V_R	max.	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	45	V
Forward current (d.c.)	I_F	max.	35	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Non repetitive peak forward current ($t \leq 1$ s)	I_{FSM}	max.	200	mA
Operating ambient temperature	T_{amb}		-50 to +60	°C

CHARACTERISTICS

		T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	typ. 0.23	typ. 0.16	V
		0.15 to 0.30	0.1 to 0.25	V
I_F = 10 mA	V_F	typ. 1.5	typ. 1.4	V
		0.8 to 2.2	0.7 to 2.1	V
I_F = 30 mA	V_F	typ. 2.8	typ. 2.6	V
		1.4 to 4.0	1.2 to 3.8	V
Reverse current				
V_R = 0.1 V	I_R	typ. 0.35	typ. 4.5	μA
		< 1.0	< 12	μA
V_R = 1.5 V	I_R	typ. 0.8	typ. 6	μA
		0.1 to 2.8	0.8 to 25	μA
V_R = 10 V	I_R	typ. 4.5	typ. 16	μA
		0.4 to 18	2.5 to 60	μA
V_R = 30 V	I_R	typ. 35	typ. 60	μA
		1.5 to 150	60 to 300	μA
V_R = 45 V	I_R	typ. 90	typ. 170	μA
		4 to 350	15 to 500	μA

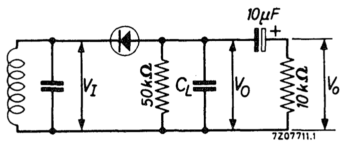
APPLICATION INFORMATION

Measuring circuit at T_{amb} = 25 °C



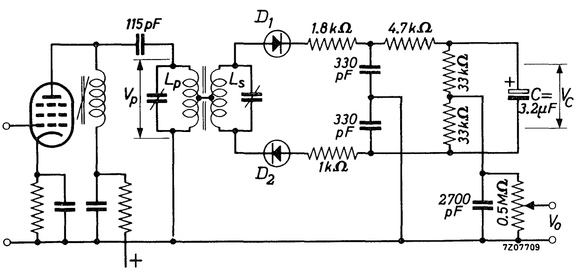
$V_{I(RMS)}$	= 3 V	η	typ.	85	%
f	= 10.7 MHz	R_d	typ.	15	kΩ
			13.5 to 19		kΩ

Diode in an a.m. detector circuit at T_{amb} = 25 °C



$V_{I(RMS)}$	= 0.1 V	V_O	typ. 55	mV
f	= 0.5 MHz	$V_{o(rms)}$	typ. 4.5	mV [1]
		R	typ. 40	kΩ [2]

Matched pair in a ratio detector circuit



L_p	=	7.4	µH
Q_0	=	80	unloaded
R	=	40	kΩ unloaded
Tap	=	0.5	
L_s	=	4.4	µH
Q_0	=	150	unloaded
R	=	45	kΩ unloaded
kQ	=	0.8 [3]	
f_0	=	10.7	MHz
Δf	=	15	kHz
m	=	0.3	

a.m. suppression factor at V_C = 2 to 20 V

$f = f_0$	α	$\geq$	30
$f = f_0 \pm 25$ kHz	α	$\geq$	15

For optimum a.m. suppression D_1 must be that diode of the matched pair which has the better dynamic forward characteristic.

FOR NEW DESIGN THE SUCCESSOR TYPES AA119; 2-AA119
ARE RECOMMENDED

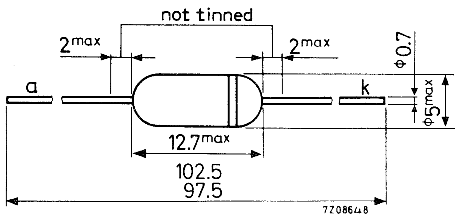
[1]) Modulation factor m = 0.3
[2]) Modulation factor m = 0
[3]) Measured in the circuit with V_p = 350 mV

POINT CONTACT DIODE

Germanium diode in all glass construction for general purposes.

MECHANICAL DATA

Dimensions in mm



The coloured band indicates the cathode

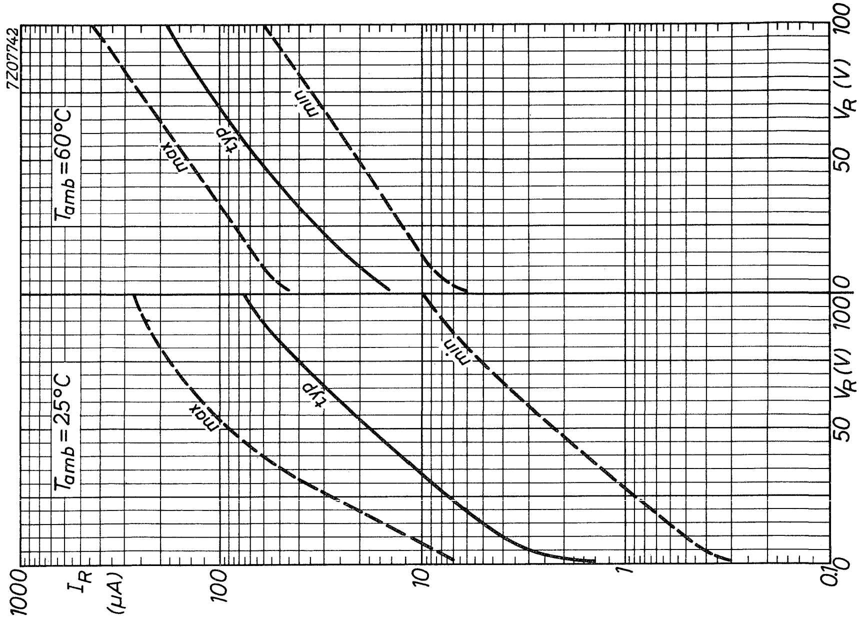
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

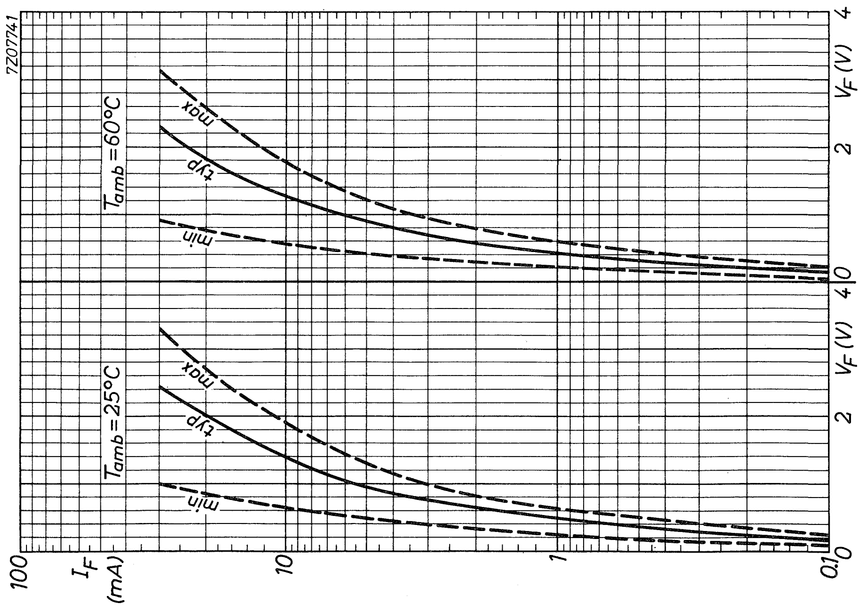
Average reverse voltage (averaged over any 50 ms period)	V_R	max.	90	V
Repetitive peak reverse voltage	V_{RRM}	max.	115	V
Average forward current (averaged over any 50 ms period)	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	mA
Operating ambient temperature	T_{amb}		−50 to +75	°C

CHARACTERISTICS

		T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	typ. 0.2	typ. 0.13	V
		0.1 to 0.25	0.05 to 0.2	V
I_F = 10 mA	V_F	typ. 1.4	typ. 1.3	V
		0.65 to 1.9	0.55 to 1.8	V
I_F = 30 mA	V_F	typ. 2.45	typ. 2.3	V
		1.0 to 3.3	0.9 to 3.15	V
Reverse current				
V_R = 1.5 V	I_R	typ. 1.5	typ. 15	μA
		0.3 to 7	6 to 45	μA
V_R = 10 V	I_R	typ. 4	typ. 20	μA
		0.5 to 11	9 to 60	μA
V_R = 75 V	I_R	typ. 40	typ. 115	μA
		5.5 to 180	35 to 260	μA
V_R = 100 V	I_R	typ. 75	typ. 190	μA
		10 to 275	60 to 450	μA

FOR NEW DESIGN THE SUCCESSOR TYPE OA91 IS RECOMMENDED


7Z07742
Tamb = 60°C
Tamb = 25°C
max
typ
min
VR (V)
IR (μA)
1000
100
10
1
0.1
0
50
100

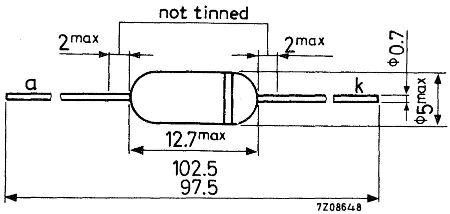

7Z07741
Tamb = 60°C
Tamb = 25°C
max
typ
min
VF (V)
IF (mA)
100
10
1
0.1
0
2
4

POINT CONTACT DIODE

Germanium diode in all glass construction for general purposes.

MECHANICAL DATA

Dimensions in mm



The coloured band indicates the cathode

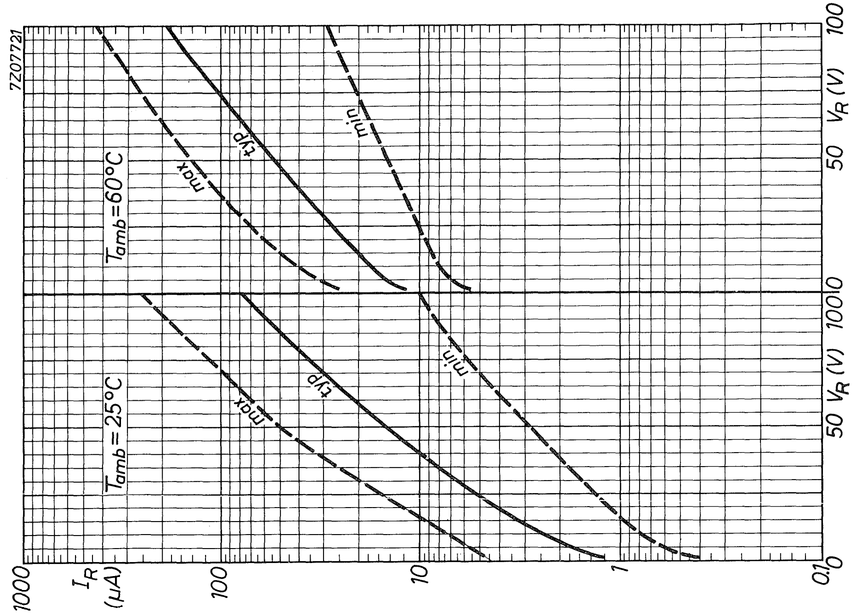
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

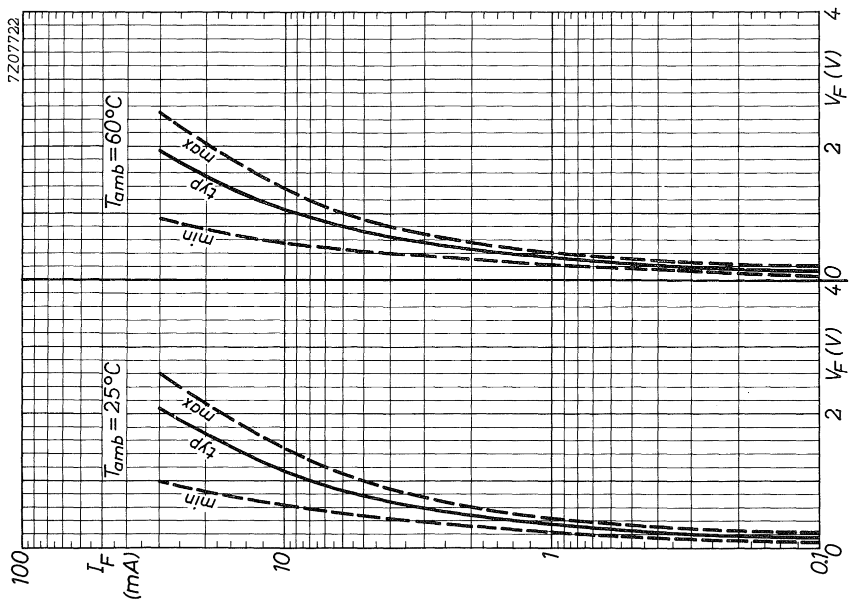
Average reverse voltage (averaged over any 50 ms period)	V_R	max.	90	V
Repetitive peak reverse voltage	V_{RRM}	max.	115	V
Average forward current (averaged over any 50 ms period)	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	mA
Operating ambient temperature	T_{amb}		−50 to +75	°C

CHARACTERISTICS

		$T_{amb} = 25$ °C	$T_{amb} = 60$ °C	
Forward voltage				
$I_F = 0.1$ mA	V_F	typ. 0.2	typ. 0.13	V
		0.1 to 0.25	0.05 to 0.2	V
$I_F = 10$ mA	V_F	typ. 1.15	typ. 1.05	V
		0.65 to 1.5	0.55 to 1.4	V
$I_F = 30$ mA	V_F	typ. 2.05	typ. 1.95	V
		1.0 to 2.6	0.9 to 2.5	V
Reverse current				
$V_R = 1.5$ V	I_R	typ. 1.2	typ. 12	μA
		0.4 to 4.5	5.5 to 26	μA
$V_R = 10$ V	I_R	typ. 2.5	typ. 17	μA
		0.8 to 7	8 to 40	μA
$V_R = 75$ V	I_R	typ. 35	typ. 100	μA
		5.7 to 110	20 to 250	μA
$V_R = 100$ V	I_R	typ. 75	typ. 190	μA
		10 to 250	30 to 430	μA

FOR NEW DESIGN THE SUCCESSOR TYPE OA95 IS RECOMMENDED


7Z07721
Tamb=60°C
Tamb=25°C
max
typ
min
max
typ
min
IR (μA)
1000
100
10
1
0.1
VR (V)
0
50
100
0
50
100


7Z07722
Tamb=60°C
Tamb=25°C
max
typ
min
max
typ
min
IF (mA)
100
10
1
0.1
VF (V)
0
2
4
0
2
4

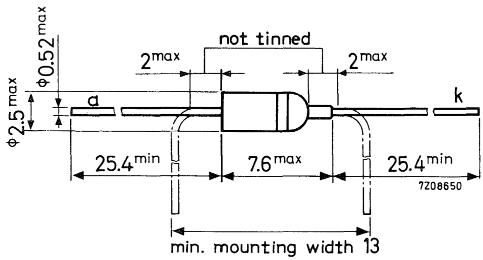
POINT CONTACT DIODE

Germanium diode in subminiature all glass DO-7 construction for use as video detector.

MECHANICAL DATA

Dimensions in mm

DO-7



The coloured band indicates the cathode

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

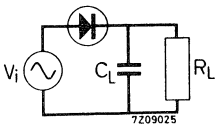
Average reverse voltage (averaged over any 50 ms period)	V_R	max.	20	V
Repetitive peak reverse voltage	V_{RRM}	max.	30	V
Non repetitive peak reverse voltage	V_{RSM}	max.	40	V
Average forward current (averaged over any 50 ms period)	I_F	max.	8	mA
Repetitive peak forward current	I_{FRM}	max.	45	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	200	mA
Storage temperature	T_{stg}		−55 to +90	°C
Operating ambient temperature	T_{amb}		−55 to +75	°C

CHARACTERISTICS

		T_{amb} = 25 °C	60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	typ. 0.18	typ. 0.12	V
		0.1 to 0.25	< 0.20	V
I_F = 10 mA	V_F	typ. 1.0	typ. 0.95	V
		0.5 to 1.5	0.4 to 1.4	V
I_F = 30 mA	V_F	typ. 2.0	typ. 1.95	V
		1.1 to 3.2	1.0 to 3.1	V
Reverse current				
V_R = 1.5 V	I_R	typ. 2.4	typ. 11	μA
		< 10	< 40	μA
V_R = 10 V	I_R	typ. 20	typ. 45	μA
		< 135	< 270	μA
V_R = 20 V	I_R	typ. 90	typ. 140	μA
		< 450	< 650	μA
V_R = 30 V	I_R	typ. 300	typ. 400	μA
		< 1100	< 1500	μA

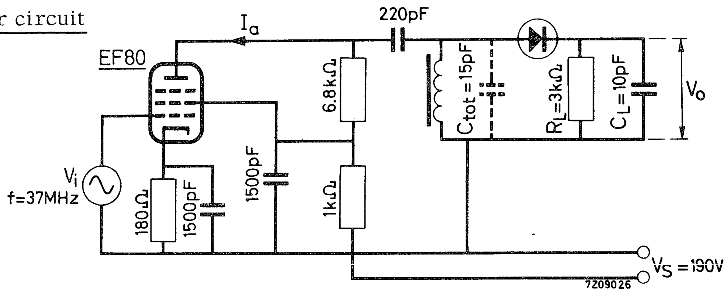
APPLICATION INFORMATION

Measuring circuit



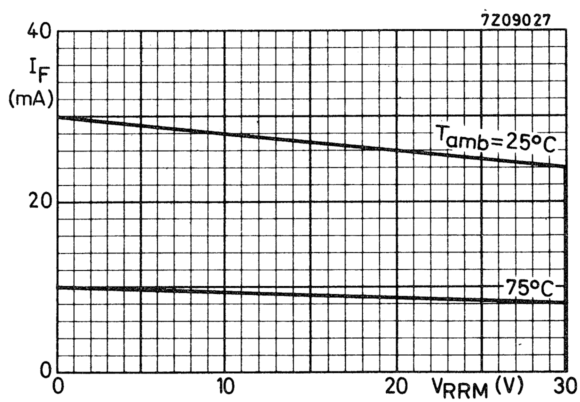
V_{im}	=	5	1.4	0.5	5	V
f	=	40	40	40	30	MHz
C_L	=	10	10	10	10	pF
R_L	=	3	3	3	3.9	kΩ
η	typ.	63	54	34	>60	%
R_d	typ.	2.4	2.8	3.7	>2.9	kΩ

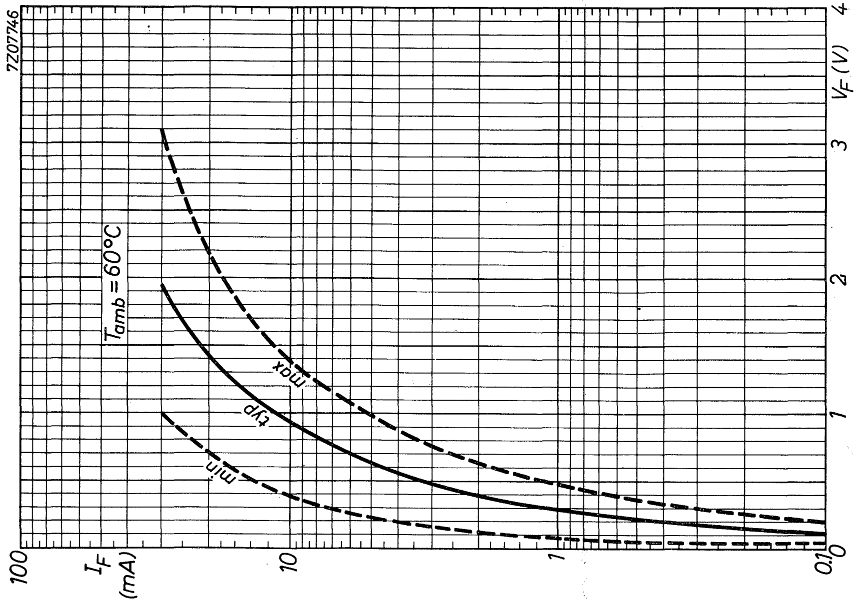
Video detector circuit

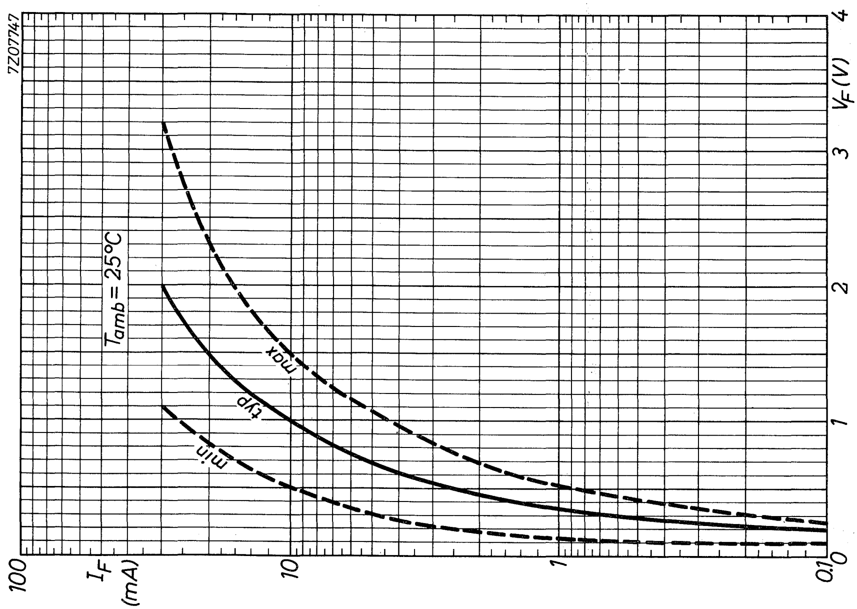


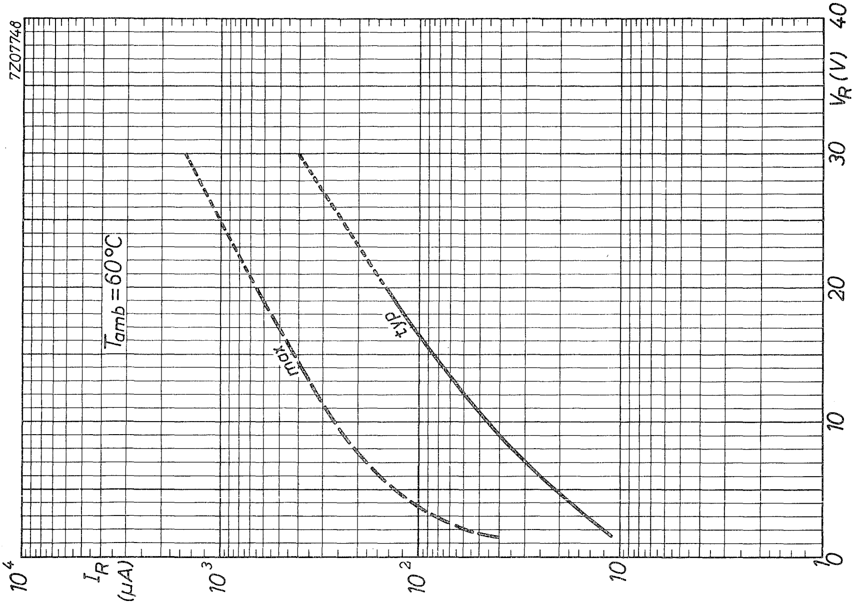
Q of the tuned circuit with removed diode: Q = 19

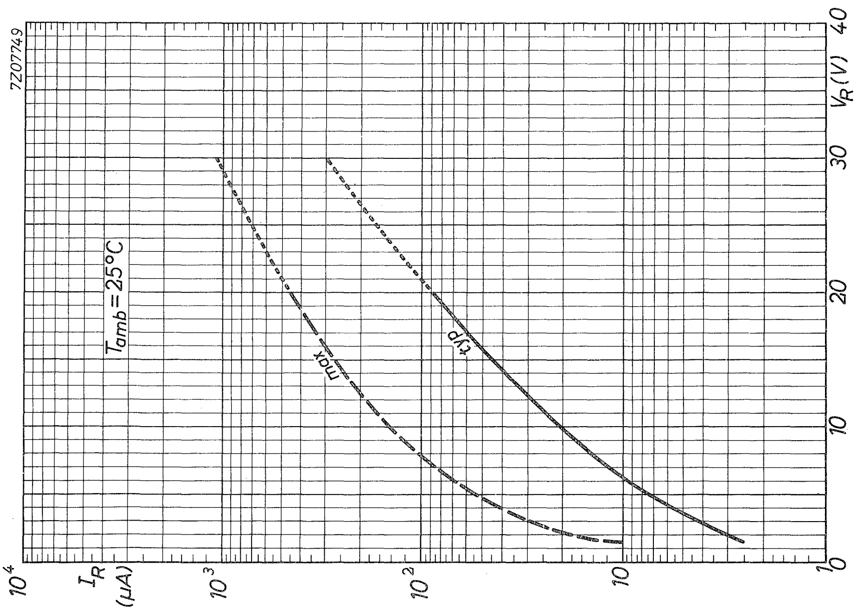
I_{am}	=	2.5	0.25	mA
B	=	4.7	4.1	MHz
V_o	typ.	2.7	0.20	V

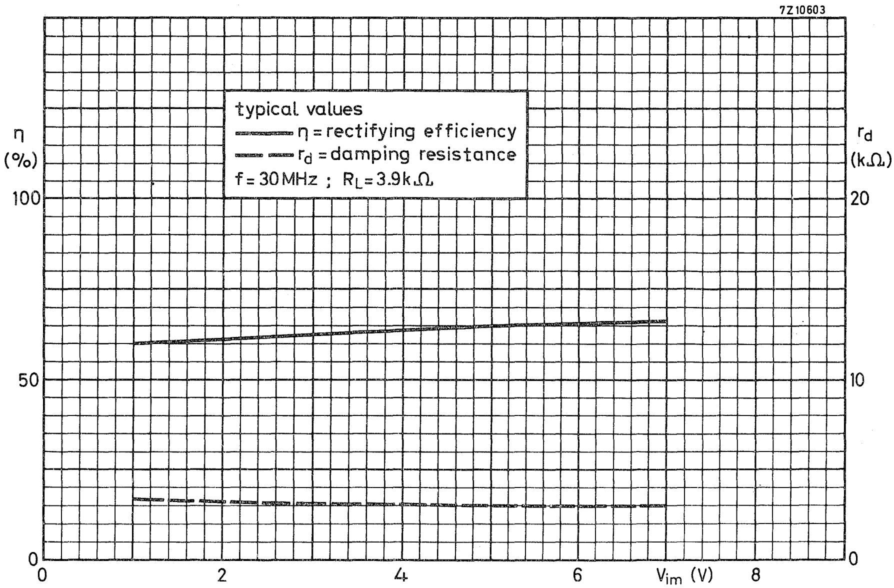



7Z07746
$T_{amb} = 60°C$
max
typ
min
I_F (mA)
100
10
1
0.1
V_F (V)
0
1
2
3
4


7Z07747
$T_{amb} = 25°C$
max
typ
min
I_F (mA)
100
10
1
0.1
V_F (V)
0
1
2
3
4


7Z07748
Tamb = 60°C
max
typ
VR (V)
IR (μA)
10 4
10 3
10 2
10
1
0
10
20
30
40


7Z07749
Tamb = 25°C
max
typ
VR (V)
IR (μA)
10 4
10 3
10 2
10
1
0
10
20
30
40

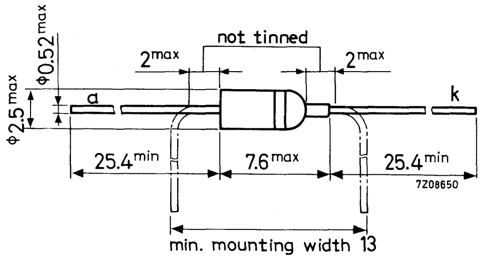

7Z10603
typical values
η = rectifying efficiency
r_d = damping resistance
f = 30 MHz ; R_L = 3.9 kΩ
η
(%)
100
50
0
r_d
(kΩ)
20
10
0
0
2
4
6
V_{im} (V)
8

POINT CONTACT DIODE

Germanium diode in subminiature all glass DO-7 construction for general purposes.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

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

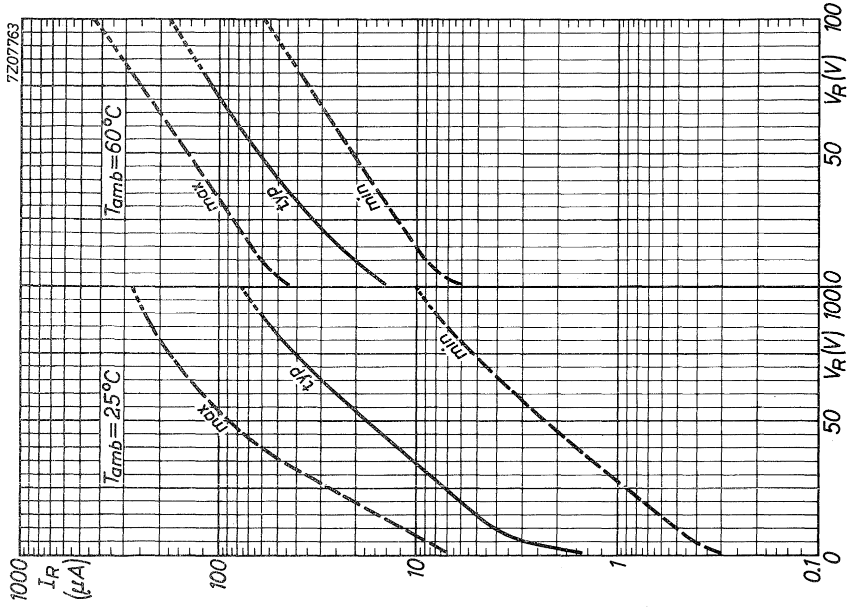
Average reverse voltage (averaged over any 50 ms period)	V_R	max.	90	V
Repetitive peak reverse voltage	V_{RRM}	max.	115	V
Average forward current (averaged over any 50 ms period)	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	mA
Storage temperature	T_{stg}		−55 to +75	°C
Operating ambient temperature	T_{amb}		−55 to +75	°C

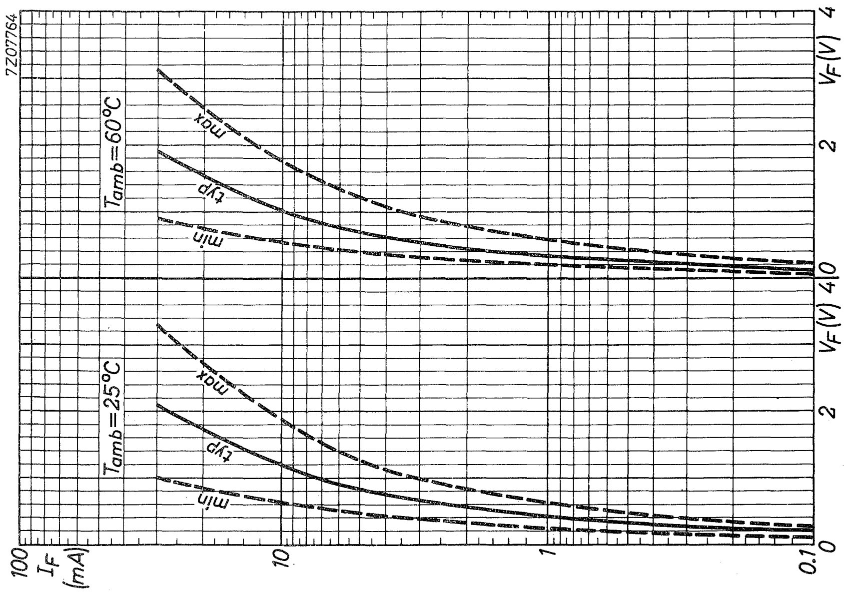
THERMAL RESISTANCE

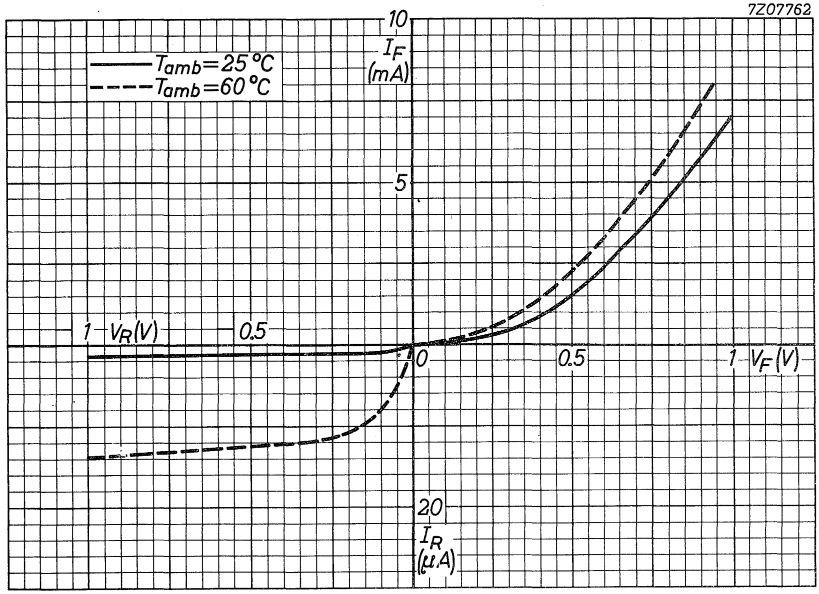
From junction to ambient in free air $R_{th\ j\text{-}a}$ = 0.4 °C/mW

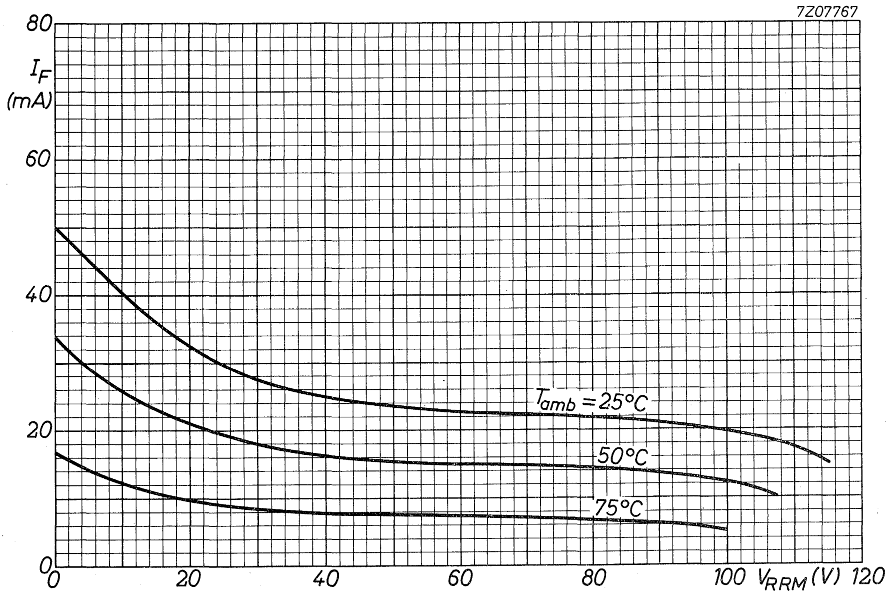
CHARACTERISTICS

		T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	typ. 0.18	typ. 0.1	V
		0.1 to 0.25	0.05 to 0.2	V
I_F = 10 mA	V_F	typ. 1.2	typ. 1.05	V
		0.65 to 1.9	0.55 to 1.8	V
I_F = 30 mA	V_F	typ. 2.1	typ. 1.9	V
		1.0 to 3.3	0.9 to 3.15	V
Reverse current				
V_R = 1.5 V	I_R	typ. 1.5	typ. 15	μA
		0.3 to 7	6 to 45	μA
V_R = 10 V	I_R	typ. 4	typ. 20	μA
		0.5 to 11	9 to 60	μA
V_R = 75 V	I_R	typ. 40	typ. 115	μA
		5.5 to 180	35 to 260	μA
V_R = 100 V	I_R	typ. 75	typ. 190	μA
		10 to 275	60 to 450	μA


7Z07763
T_{amb} = 60°C
T_{amb} = 25°C
max
typ
min
I_R (μA)
1000
100
10
1
0.1
V_R (V)
0
50
100


7Z07764
T_{amb} = 60°C
T_{amb} = 25°C
max
typ
min
I_F (mA)
100
10
1
0.1
V_F (V)
0
2
4


7Z07762
10
I_F
(mA)
5
T_{amb}=25 °C
T_{amb}=60 °C
1 V_R(V)
0.5
0
0.5
1 V_F(V)
20
I_R
(µA)


7Z07767
80
I_F
(mA)
60
40
20
0
T_{amb} = 25°C
50°C
75°C
0
20
40
60
80
100 V_{RRM} (V) 120

POINT CONTACT DIODE

Germanium diode in subminiature all glass DO-7 envelope, intended for switching applications.

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

Continuous reverse voltage	V_R	max.	15	V
Repetitive peak reverse voltage	V_{RRM}	max.	15	V
Non repetitive peak reverse voltage ($t < 1$ 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	^oC
Storage temperature	T_{stg}	−55 to	+90	^oC

THERMAL RESISTANCE

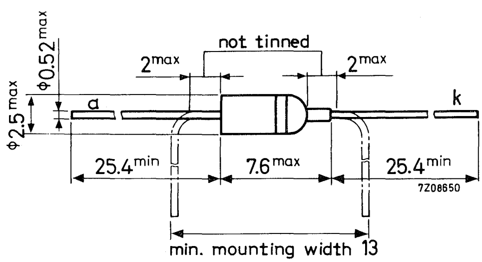
From junction to ambient	$R_{th\,j\text{-}a}$	=	0.55	$^oC/mW$

CHARACTERISTICS

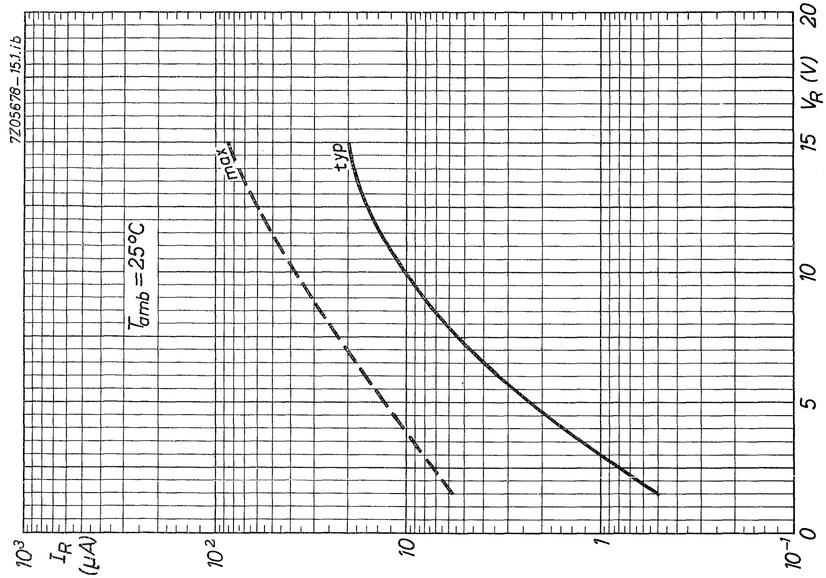
Forward voltage at T_{amb} = 25 ^oC				
I_F = 3 mA	V_F	typ.	0.55	V
		0.30 to	1.00	V
Reverse current at T_{amb} = 60 ^oC				
V_R = 15 V	I_R	typ.	40	μA
		<	155	μA
Reverse recovery current when switched from I_F = 5 mA to V_R = 5 V; T_{amb} = 25 ^oC				
measured at t_{rr} = 0.5 μs	I_R	typ.	80	μA
		<	300	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 ^oC	C_d	<	0.5	pF

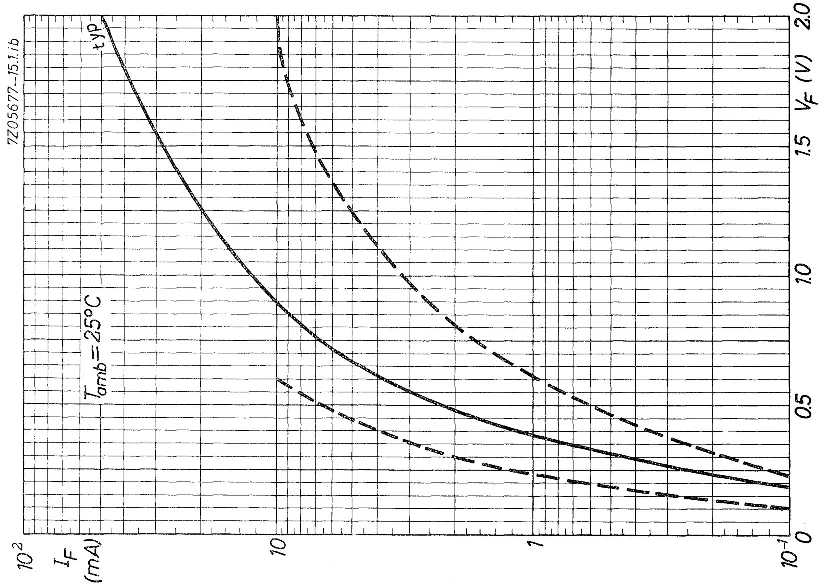
MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode


7Z05678-15.1.ib
$T_{amb} = 25°C$
max
typ
I_R (μA)
V_R (V)
10^3
10^2
10
1
10^{-1}
0
5
10
15
20

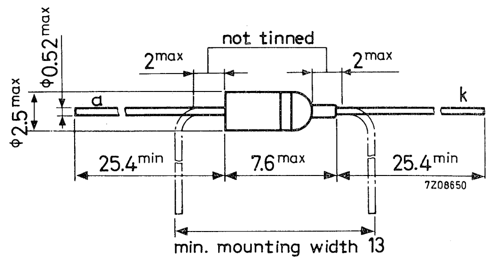

7Z05677-15.1.ib
$T_{amb} = 25°C$
typ
I_F (mA)
V_F (V)
10^2
10
1
10^{-1}
0
0.5
1.0
1.5
2.0

POINT CONTACT DIODE

Germanium diode in subminiature all glass DO-7 construction for general purposes.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

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

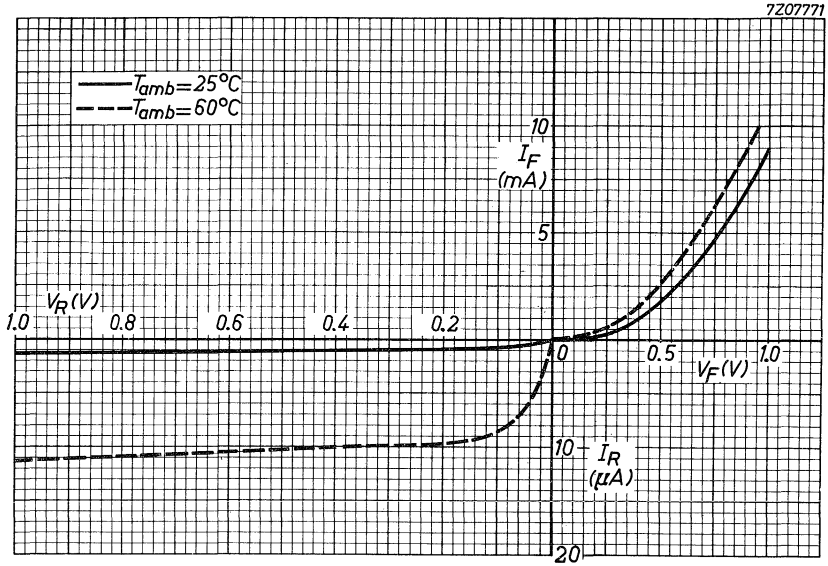
Average reverse voltage (averaged over any 50 ms period)	V_R	max.	90	V
Repetitive peak reverse voltage	V_{RRM}	max.	115	V
Average forward current (averaged over any 50 ms period)	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	mA
Storage temperature	T_{stg}		−55 to +75	°C
Operating ambient temperature	T_{amb}		−55 to +75	°C

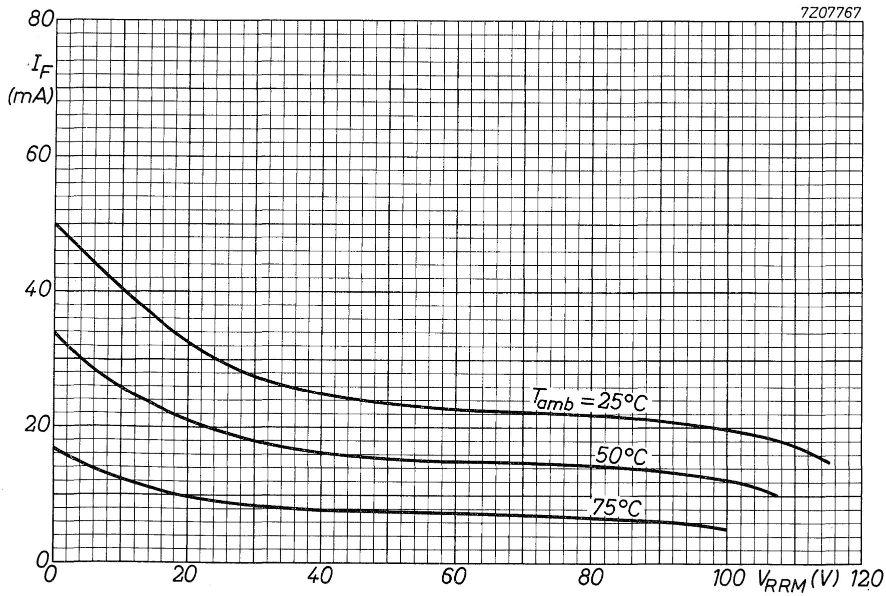
THERMAL RESISTANCE

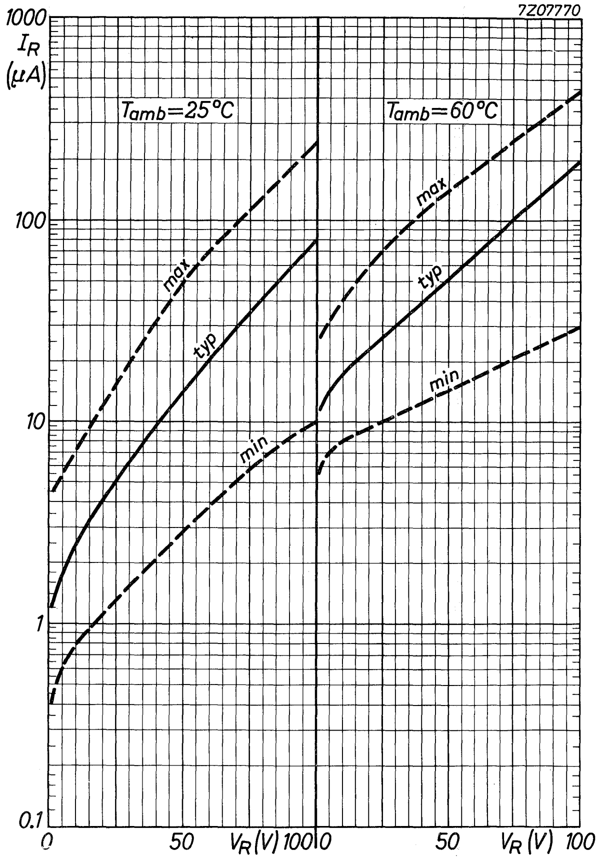
From junction to ambient in free air $R_{th\ j\text{-}a}$ = 0.4 °C/mW

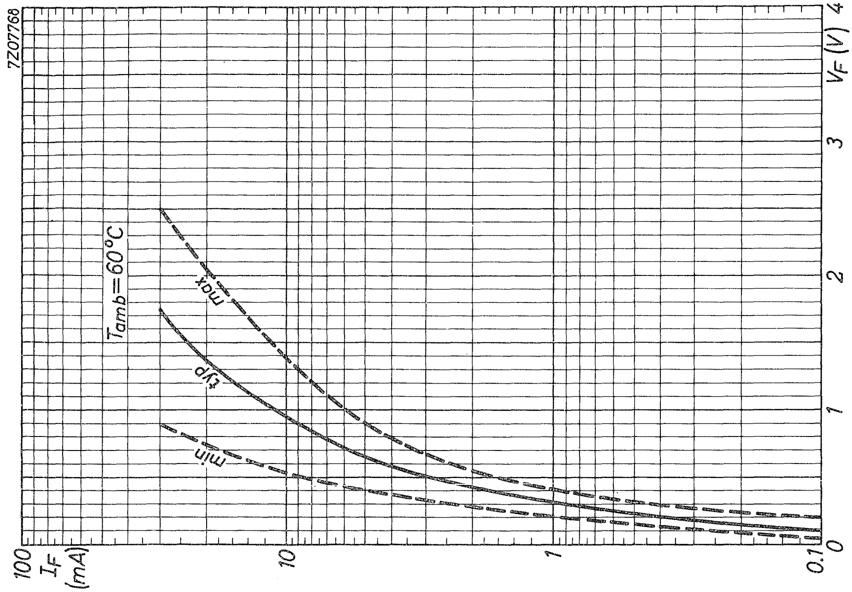
CHARACTERISTICS

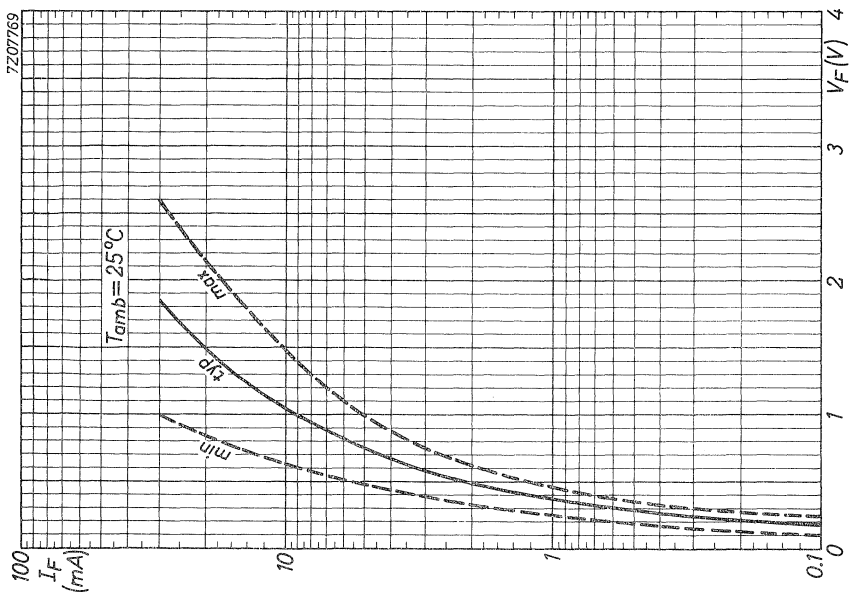
		T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	typ. 0.18	typ. 0.1	V
		0.1 to 0.25	0.05 to 0.2	V
I_F = 10 mA	V_F	typ. 1.05	typ. 0.95	V
		0.65 to 1.5	0.55 to 1.4	V
I_F = 30 mA	V_F	typ. 1.85	typ. 1.75	V
		1.0 to 2.6	0.9 to 2.5	V
Reverse current				
V_R = 1.5 V	I_R	typ. 1.2	typ. 12	μA
		0.4 to 4.5	5.5 to 26	μA
V_R = 10 V	I_R	typ. 2.5	typ. 17	μA
		0.8 to 7	8 to 40	μA
V_R = 75 V	I_R	typ. 35	typ. 100	μA
		5.7 to 110	20 to 250	μA
V_R = 100 V	I_R	typ. 80	typ. 200	μA
		10 to 250	30 to 430	μA


7Z07771
$T_{amb}=25°C$
$T_{amb}=60°C$
10
I_F (mA)
5
V_R (V)
1.0
0.8
0.6
0.4
0.2
0
0.5
1.0
V_F (V)
10
I_R (µA)
20


7Z07767
80
I_F (mA)
60
40
20
0
$T_{amb}=25°C$
50°C
75°C
0
20
40
60
80
100
V_{RRM} (V)
120


7Z07770
1000
I_R
(μA)
100
10
1
0.1
T_{amb}=25°C
T_{amb}=60°C
max
typ
min
max
typ
min
0
50
V_R(V) 100
0
50
V_R(V) 100


7Z07768
T_{amb}=60°C
max
typ
min
100
I_F
(mA)
10
1
0.1
0
1
2
3
4
V_F(V)


7Z07769
T_{amb}=25°C
max
typ
min
100
I_F
(mA)
10
1
0.1
0
1
2
3
4
V_F(V)

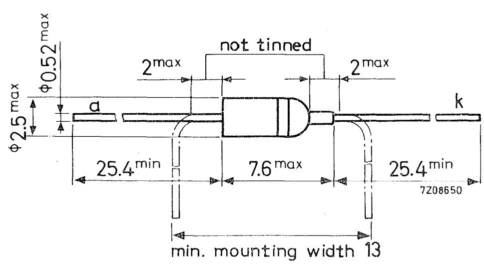
SILICON DIODES

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	250	mA
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.4	0.4	^{o}C/mW
Forward voltage I_F = 30 mA; T_{amb} = 25 ^{o}C	V_F	typ.	0.9	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	3.5	μs

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

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 4)	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	$R_{th\,j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS

Forward voltage

				T_{amb} = 25 °C	T_{amb} = 125 °C	
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

				T_{amb} = 25 °C	T_{amb} = 125 °C	
$V_R = V_{Rmax}$	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.

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

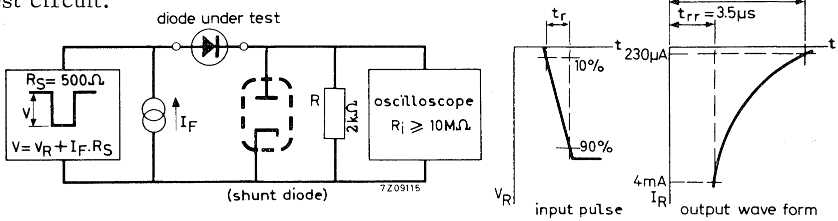
Reverse recovery current when switched from

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

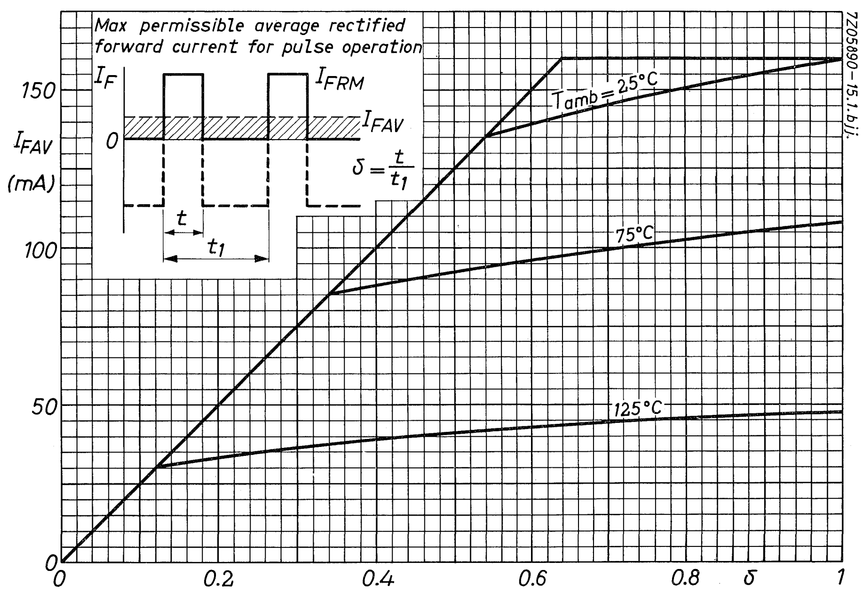
I_F = 30 mA to V_R = 35 V; R_L = 2.5 kΩ				
measured at t_{rr} = 3.5 μs	I_R	typ.	4	mA
t_{rr} = 10 μs	I_R	typ.	230	μA

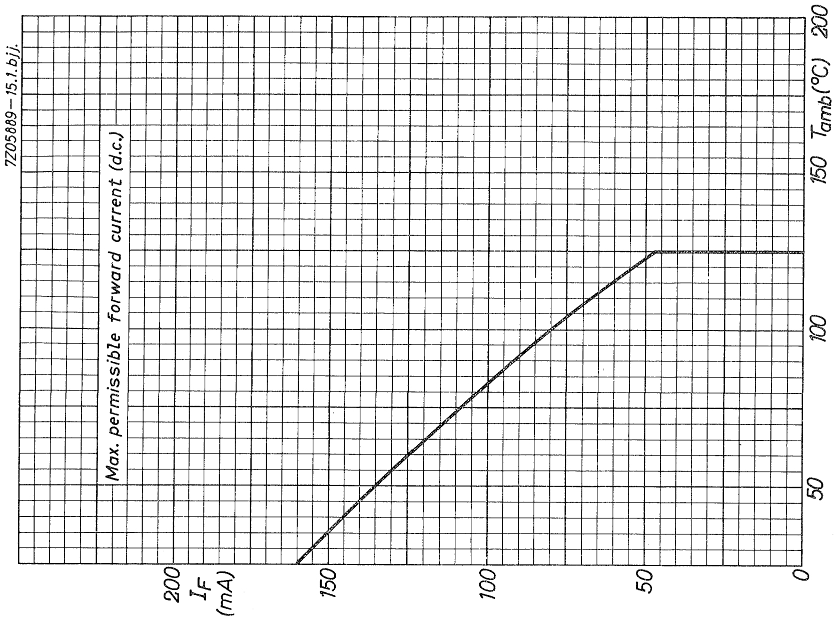
Test circuit:

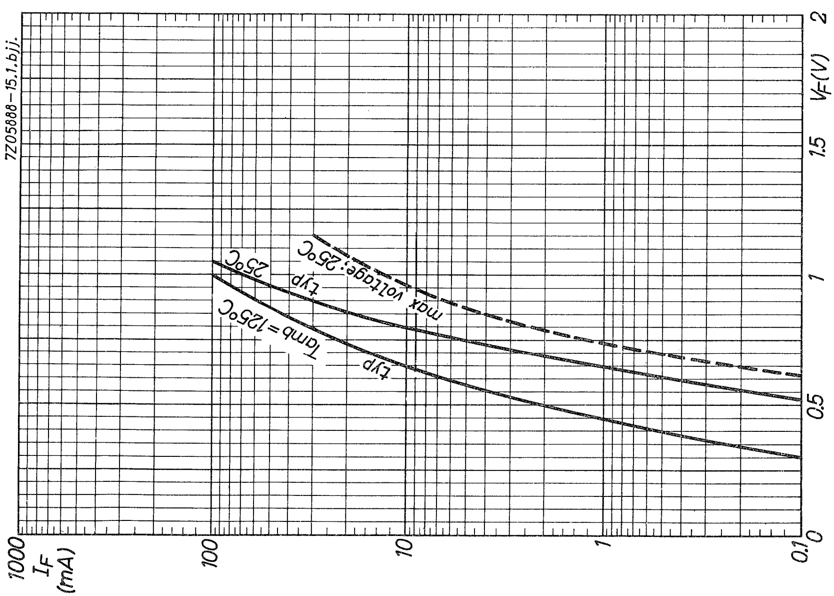


Reverse pulse: Rise time $t_r \leq 0.1$ μs
Duty cycle δ = 0.5
Frequency f = 50 kHz

Oscilloscope: Capacitance C = 40 pF
Rise time t_r = 25 ns




7Z05889−15.1.bjj.
Max. permissible forward current (d.c.)
T_{amb} (°C)
0
50
100
150
200
I_F (mA)
0
50
100
150
200


7Z05888−15.1.bjj.
V_F (V)
0
0.5
1
1.5
2
I_F (mA)
0.1
1
10
100
1000
max voltage; 25°C
typ 25°C
typ T_{amb} = 125°C

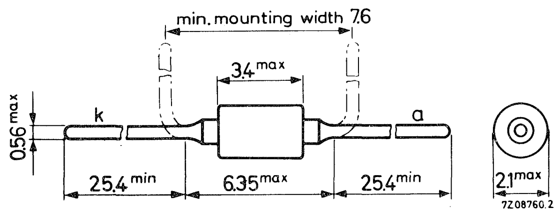
SILICON OXIDE PASSIVATED DIODES

Whiskerless diodes in a hard glass subminiature envelope.
These high speed diodes are primarily intended for fast logic applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	V
Repetitive peak forward current	I_{FRM}	max.	225	mA
Forward voltage 1N914 : I_F = 10 mA 1N914A: I_F = 20 mA 1N914B: I_F = 100 mA	V_F	<	1	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

MECHANICAL DATA

Dimensions in mm



E.I.A. colour code

RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage		V_R	max.	75	V
Repetitive peak reverse voltage		V_{RRM}	max.	100	V

Currents

Average rectified forward current (averaged over any 20 ms period)	$T_{amb} = 25\ ^oC$	I_{FAV}	max.	75	mA
	$T_{amb} = 150\ ^oC$	I_{FAV}	max.	10	mA
Forward current (d.c.)		I_F	max.	75	mA
Repetitive peak forward current		I_{FRM}	max.	225	mA
Non repetitive peak forward current (t = 1 s)		I_{FSM}	max.	500	mA
Total power dissipation		P_{tot}	max.	250	mW

Temperatures

Storage temperature	T_{stg}	−65 to +200	^oC
Operating ambient temperature	T_{amb}	−65 to +175	^oC

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

Forward voltages

1N914 : I_F = 10 mA; 1N914A: I_F = 20 mA; 1N914B: I_F = 100 mA	V_F	<	1	V
1N914B: I_F = 5 mA	V_F		0.62 to 0.72	V

Reverse breakdown voltage

I_R = 100 μA	$V_{(BR)R}$	>	100	V

Reverse currents

V_R = 20 V	I_R	<	25	nA
V_R = 75 V	I_R	<	5	μA
V_R = 20 V; T_j = 150 ^oC	I_R	<	50	μA
1N914B: V_R = 100 V	I_R	<	100	μA

Diode capacitance

V_R = 0; f = 1 MHz	C_d	<	4	pF

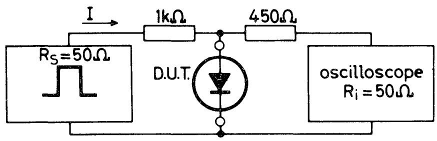
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

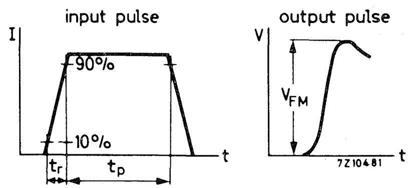
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Forward recovery voltage when switched to

I_F = 50 mA; t_r = 20 ns V_{FM} < 2.5 V

Test circuit:





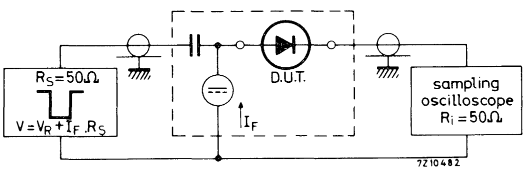
Current pulse:	Rise time	t_r	=	20	ns	Oscilloscope:		
	Pulse duration	t_p	=	120	ns	Rise time	t_r = 0.35	ns
	Duty cycle	δ	=	0.01				

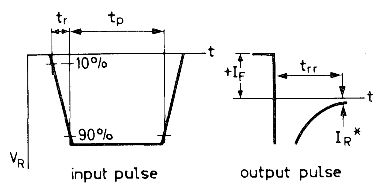
Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

I_F = 10 mA to V_R; R_L = 100 Ω
measured at I_R = 1 mA; switched to V_R = 1 V t_{rr} < 8 ns
V_R = 6 V t_{rr} < 4 ns

Test circuit:





*) I_R = 1 mA

Reverse pulse:	Rise time	t_r	=	0.6	ns	Oscilloscope:		
	Pulse duration	t_p	=	100	ns	Rise time	t_r = 0.35	ns
	Duty cycle	δ	=	0.05				

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

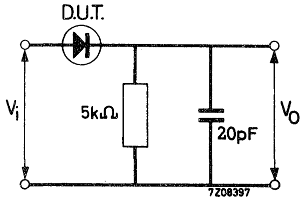
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Rectifying efficiency

$$\eta = \frac{V_O}{V_{i(rms)}\sqrt{2}}$$

f = 100 MHz; $V_{i(rms)}$ = 2 V	η	>	45	%

Test circuit:



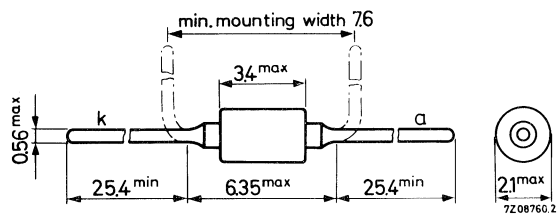
SILICON OXIDE PASSIVATED DIODES

Whiskerless diodes in a hard glass subminiature envelope.
These high speed diodes are primarily intended for fast logic applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	V
Repetitive peak forward current	I_{FRM}	max.	225	mA
Forward voltage 1N916 : I_F = 10 mA 1N916A: I_F = 20 mA 1N916B: I_F = 30 mA	V_F	<	1	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

MECHANICAL DATA

Dimensions in mm



E.I.A. colour code

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

Voltages

Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	V

Currents

Average rectified forward current				
(averaged over any 20 ms period) T_{amb} = 25 °C	I_{FAV}	max.	75	mA
T_{amb} = 150 °C	I_{FAV}	max.	10	mA
Forward current (d.c.)	I_F	max.	75	mA
Repetitive peak forward current	I_{FRM}	max.	225	mA
Non repetitive peak forward current (t = 1 s)	I_{FSM}	max.	500	mA
Total power dissipation	P_{tot}	max.	250	mW

Temperatures

Storage temperature	T_{stg}	-65 to +200	°C
Operating ambient temperature	T_{amb}	-65 to +175	°C

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltages

1N916 : I_F = 10 mA 1N916A: I_F = 20 mA 1N916B : I_F = 30 mA	V_F	<	1	V
1N916B : I_F = 5 mA	V_F		0.63 to 0.73	V

Reverse breakdown voltage

I_R = 100 μA	$V_{(BR)R}$	>	100	V

Reverse currents

V_R = 20 V	I_R	<	25	nA
V_R = 75 V	I_R	<	5	μA
V_R = 20 V; T_j = 150 °C	I_R	<	50	μA

Diode capacitance

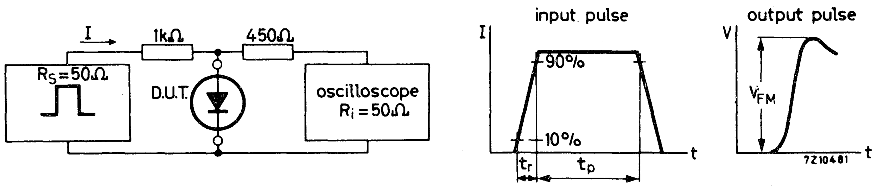
V_R = 0; f = 1 MHz	C_d	<	2	pF

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

Forward recovery voltage when switched to

I_F = 50 mA; t_r = 20 ns V_{FM} < 2.5 V

Test circuit:



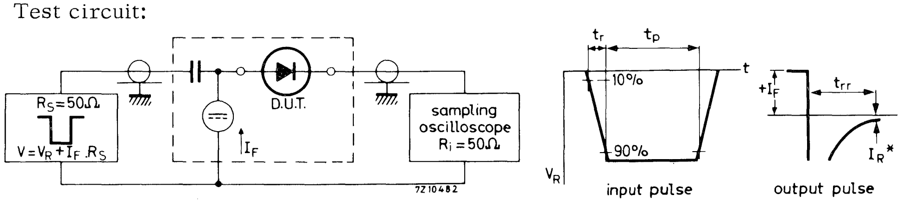
Current pulse:	Rise time	t_r = 20 ns	Oscilloscope:	
	Pulse duration	t_p = 120 ns	Rise time	t_r = 0.35 ns
	Duty cycle	δ = 0.01		

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

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

Test circuit:



*) I_R = 1 mA

Reverse pulse:	Rise time	t_r = 0.6 ns	Oscilloscope:	
	Pulse duration	t_p = 100 ns	Rise time	t_r = 0.35 ns
	Duty cycle	δ = 0.05		

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

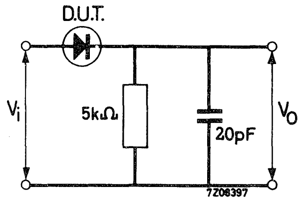
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Rectifying efficiency

$$\eta = \frac{V_O}{V_{i(rms)}\sqrt{2}}$$

f = 100 MHz; $V_{i(rms)}$ = 2 V η > 45 %

Test circuit:



ULTRA HIGH SPEED SILICON DIODE

General purpose diode for military and industrial applications.

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

Voltage

Continuous reverse voltage at T_{amb} = 25 °C	V_R	max.	25	V

Power dissipation

Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	250	mW

Temperature

Storage temperature	T_{stg}	−65 to +200	°C

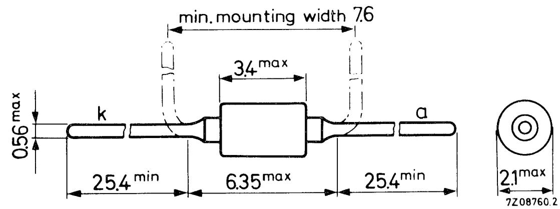
THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.6	°C/mW

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

Forward voltage				
I_F = 30 mA	V_F	<	1	V
Reverse breakdown voltage				
I_R = 5 μA	$V_{(BR)R}$	>	35	V
Reverse currents				
V_R = 25 V	I_R	<	0.1	μA
V_R = 25 V; T_{amb} = 150 °C	I_R	<	100	μA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	4	pF

MECHANICAL DATA Dimensions in mm



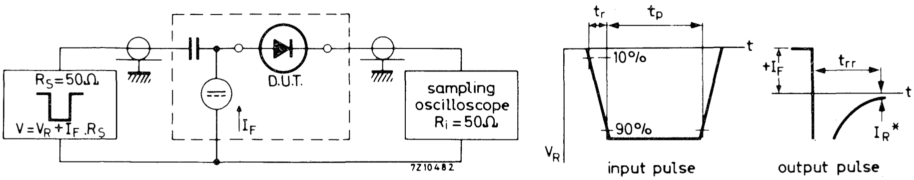
E.I.A. colour code

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

Reverse recovery time when switched from

I_F = 10 mA to V_R; R_L = 100 Ω				
measured at I_R = 1 mA; switched to V_R = 1 V	t_{rr}	<	4	ns
V_R = 6 V	t_{rr}	<	2	ns

Test circuit:



*) I_R = 1 mA

Reverse pulse:					Oscilloscope:				
Rise time	t_r	≤	0.5	ns	Rise time	t_r	≤	0.6	ns

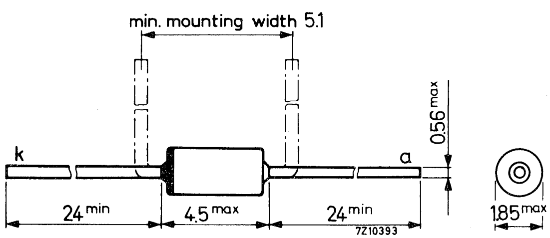
ULTRA HIGH SPEED SILICON DIODES

Whiskerless diodes in a subminiature DO-35 envelope.
These high speed diodes are primarily intended for fast logic applications.

QUICK REFERENCE DATA					
Continuous reverse voltage		V_R	max.	75	V
Repetitive peak reverse voltage		V_{RRM}	max.	75	V
Repetitive peak forward current	1N4148	I_{FRM}	max.	225	mA
	1N4446; 1N4448	I_{FRM}	max.	450	mA
Forward voltage 1N4148: I_F = 10 mA 1N4446: I_F = 20 mA 1N4448: I_F = 100 mA		V_F	<	1	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

MECHANICAL DATA Dimensions in mm

DO-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

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

			1N4148	1N4446 1N4448	
Voltages					
Continuous reverse voltage	V_R	max.	75	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	75	V
Currents					
Average rectified forward current	I_{FAV}	max.	75	150	mA
Forward current (d.c.)	I_F	max.	75	200	mA
Repetitive peak forward current	I_{FRM}	max.	225	450	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	2000	2000	mA
$t = 1$ s	I_{FSM}	max.	500	500	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	500		mW
Derating factor			2.85		mW/^oC
Temperatures					
Storage temperature	T_{stg}		−65 to +200		^oC
Junction temperature	T_j	max.	200		^oC

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

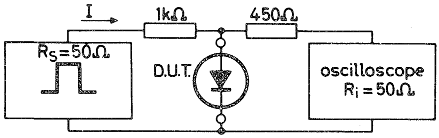
Forward voltages					
1N4148: $I_F = 10$ mA; 1N4446: $I_F = 20$ mA; 1N4448: $I_F = 100$ mA		V_F	<	1	V
1N4448: $I_F = 5$ mA		V_F		0.62 to 0.72	V
Reverse breakdown voltage					
$I_R = 100\ \mu A$		$V_{(BR)R}$	>	100	V
$I_R = 5\ \mu A$		$V_{(BR)R}$	>	75	V
Reverse currents					
$V_R = 20$ V		I_R	<	25	nA
$V_R = 20$ V; $T_j = 100\ ^oC$	1N4448	I_R	<	3	μA
$V_R = 20$ V; $T_j = 150\ ^oC$		I_R	<	50	μA
Diode capacitance					
$V_R = 0$; f = 1 MHz		C_d	<	4	pF

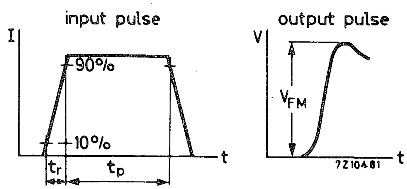
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Forward recovery voltage when switched to

I_F = 50 mA; t_r = 20 ns 1N4448 V_{FM} < 2.5 V

Test circuit:





Current pulse: Rise time t_r = 20 ns
Pulse duration t_p = 120 ns
Duty cycle δ = 0.01

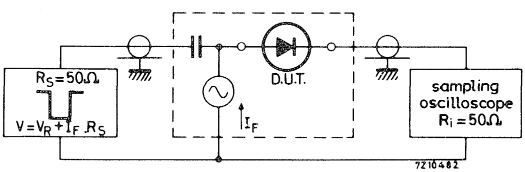
Oscilloscope:
Rise time t_r = 0.35 ns

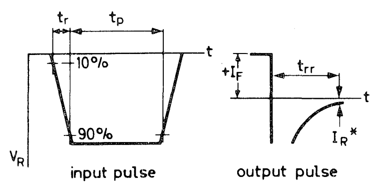
Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

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

Test circuit:





*) I_R = 1 mA

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

Oscilloscope:
Rise time t_r = 0.35 ns

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

ULTRA HIGH SPEED SILICON DIODES

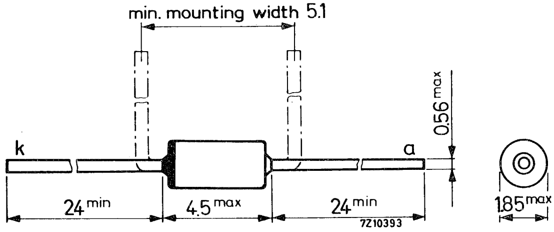
Whiskerless diodes in a subminiature DO-35 envelope.
The 1N4150 is primarily intended for general purpose use in computer and industrial applications. The 1N4151 and 1N4154 are intended for military and industrial applications.

QUICK REFERENCE DATA

			1N4150	1N4151	1N4154	
Continuous reverse voltage	V_R	max.	50	50	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	–	75	–	V
Repetitive peak forward current	I_{FRM}	max.	0.60	0.45	0.45	A
Non repetitive peak forward current						
t = 1 μs	I_{FSM}	max.	4	–	–	A
t = 1 s	I_{FSM}	max.	0.5	–	–	A
Forward voltage						
I_F = 30 mA	V_F	<	–	–	1	V
I_F = 50 mA	V_F	<	–	1	–	V
I_F = 200 mA	V_F	<	1	–	–	V
Reverse recovery time when switched from: I_F = 400 mA to I_R = 400 mA measured at I_R = 40 mA	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	<	–	4	4	ns

MECHANICAL DATA Dimensions in mm

DO-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

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

Voltages			1N4150	1N4151	1N4154	
Continuous reverse voltage	V_R	max.	50	50	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	–	75	–	V
Currents						
Forward current (d.c.)	I_F	max.	0.3	0.2	0.2	A
Repetitive peak forward current	I_{FRM}	max.	0.60	0.45	0.45	A
Non repetitive peak forward current						
t = 1 μs	I_{FSM}	max.	4	–	–	A
t = 1 s	I_{FSM}	max.	0.5	–	–	A

Total power dissipation				
up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Derating factor			2.85	mW/°C
Temperatures				
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C

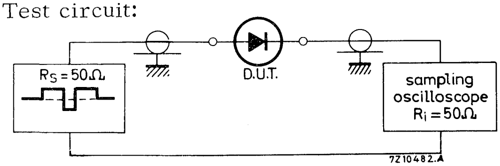
CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

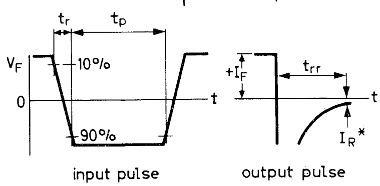
Forward voltages			1N4150	1N4151	1N4154	
I_F = 1 mA	V_F	>	0.54	–	–	V
		<	0.62	–	–	V
I_F = 10 mA	V_F	>	0.66	–	–	V
		<	0.74	–	–	V
I_F = 30 mA	V_F	<	–	–	1	V
I_F = 50 mA	V_F	>	0.76	–	–	V
		<	0.86	1	–	V
I_F = 100 mA	V_F	>	0.82	–	–	V
		<	0.92	–	–	V
I_F = 200 mA	V_F	>	0.87	–	–	V
		<	1	–	–	V
Reverse breakdown voltage						
I_R = 5 μA	$V_{(BR)R}$	>	–	75	35	V
Reverse currents						
V_R = 25 V	I_R	<	–	–	0.1	μA
V_R = 25 V; T_{amb} = 150 °C	I_R	<	–	–	100	μA
V_R = 50 V	I_R	<	0.1	0.05	–	μA
V_R = 50 V; T_{amb} = 150 °C	I_R	<	100	50	–	μA

CHARACTERISTICS (continued)

			1N4150	1N4151	1N4154	
Diode capacitance						
$V_R = 0$; f = 1 MHz	C_d	<	2.5	2	4	pF
Reverse recovery time when switched from:						
I_F = 10 to 100 mA to I_R = 10 to 100 mA measured at $I_R = 0.1 \times I_F$	t_{rr}	<	4	–	–	ns
I_F = 200 to 400 mA to I_R = 200 to 400 mA measured at $I_R = 0.1 \times I_F$	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 1 mA measured at I_R = 0.1 mA	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	<	–	4	4	ns
I_F = 10 mA to V_R = 6 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	–	2	2	ns

Test circuit:





* value at which t_{rr} is measured

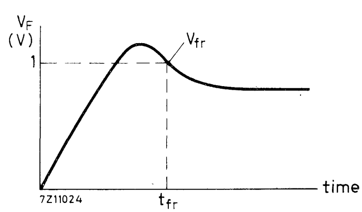
Reverse pulse: Rise time t_r = 0.5 ns
Pulse duration t_p = 100 μs
Duty cycle δ = 0.05

Oscilloscope:
Rise time t_r = 0.6 ns

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

Forward recovery time when switched from

$I = 0$ to I_F = 200 mA
t_r = 0.4 ns; t_p = 100 ns
$\delta < 0.01$; measured at V_{fr} = 1 V — 1N4150 — t_{fr} < 10 ns



Tunnel diodes

TUNNEL DIODES

Germanium tunnel diodes in a DO-17 metal envelope primarily intended for very high speed switching, flip-flops, memories, frequency dividers, level shifters, pulse regenerations. They are also suitable for use in oscillators, mixers and limiters.

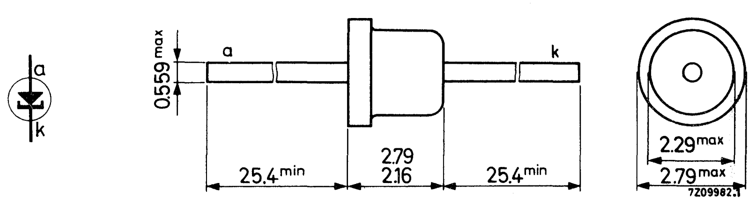
QUICK REFERENCE DATA

			AEY23	AEY24	AEY25	AEY26	AEY27	AEY28	
Forward current (peak value)	I_{FM}	max.	10	25	50	50	100	100	mA
Reverse current (peak value)	I_{RM}	max.	10	25	50	50	100	100	mA
Peak point current	I_P	typ.	1	2.5	4.7	5	10	20	mA
Peak point voltage	V_P	typ.	65	70	75	75	80	80	mV
Valley point voltage	V_V	typ.	300	320	330	330	340	360	mV
Peak to valley point current ratio	I_P/I_V	<	6	6	6	6	6	6	

MECHANICAL DATA

Dimensions in mm

Cathode connected to case
DO-17



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

			AEY23	AEY24	AEY25	AEY26	AEY27	AEY28	
Forward current (peak value)	I_{FM}	max.	10	25	50	50	100	100	mA
Reverse current (peak value)	I_{RM}	max.	10	25	50	50	100	100	mA
Storage temperature	T_{stg}		−40 to +90						°C

CHARACTERISTICS

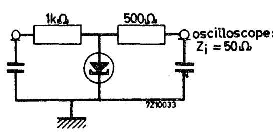
			AEY23	AEY24	AEY25	AEY26	AEY27	AEY28	
Peak point current	I_P	>	0.95	2.4	4.5	4.75	9.5	19	mA
		typ.	1.0	2.5	4.7	5.0	10	20	mA
		<	1.05	2.6	4.9	5.25	10.5	21	mA
Temperature coefficient of peak point current	$\lvert\Delta I_P/\Delta T_{amb}\rvert$	<	0.3	0.3	0.3	0.3	0.3	0.3	%/°C
Peak to valley point current ratio	I_P/I_V	>	4	4	4	4	4	4	
		<	6	6	6	6	6	6	
Temperature coefficient of valley point current	$\Delta I_V/\Delta T_{amb}$	typ.	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	%/°C
Peak point voltage	V_P	typ.	65	70	75	75	80	80	mV
		<	80	90	90	90	100	100	mV
Temperature coefficient of peak point voltage	$\Delta V_P/\Delta T_{amb}$	typ.	−0.1	−0.1	−0.1	−0.1	−0.1	−0.1	mV/°C
Valley point voltage	V_V	typ.	300	320	330	330	340	360	mV
Temperature coefficient of valley point voltage	$\Delta V_V/\Delta T_{amb}$	typ.	−0.5	−0.5	−0.5	−0.5	−0.5	−0.5	mV/°C
Projected peak point voltage	V_{PP}	typ.	480	480	480	480	500	510	mV
Temperature coefficient of projected peak point voltage	$\Delta V_{PP}/\Delta T_{amb}$	typ.	−1	−1	−1	−1	−1	−1	mV/°C

CHARACTERISTICS (see also test circuit) T_{amb} = 25 °C

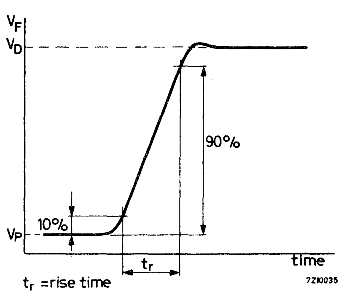
			AEY23	AEY24	AEY25	AEY26	AEY27	AEY28	
Rise time (see figures below) $t_r \approx \frac{V_{PP} - V_P}{I_P - I_V} \cdot C_{tot}$	t_r	typ.	1.5	1.0	0.8	0.8	0.7	0.5	ns
		<	4.0	2.5	2.0	2.0	1.5	1.2	ns
Terminal capacitance	C_{tot}	typ.	3	6	8	8	15	25	pF
		<	6	10	15	15	30	50	pF
Parasitic capacitance	C_p	typ.	0.6	0.6	0.6	0.6	0.6	0.6	pF
Series inductance with minimum lead length	L_s	typ.	3	3	3	3	3	3	nH
Series resistance	r_s	typ.	5	3.5	2.5	2.5	1.8	1.0	Ω
Negative conductance of the intrinsic diode	g_j	typ.	6.5	14	33	33	65	100	mΩ^{-1}
Resistive cut-off frequency $f_r = \frac{1}{2\pi} \cdot \frac{g_j}{C_j} \sqrt{\frac{1}{g_j r_s} - 1}$	f_r	typ.	2.4	1.8	2.4	2.4	2.0	1.4	GHz
Resonance frequency $f_0 = \frac{1}{2\pi\sqrt{L_s C_j}} \sqrt{1 - \frac{L_s g_j^2}{C_j}}$	f_0	typ.	1.8	1.2	0.8	0.8	0.3	–	GHz

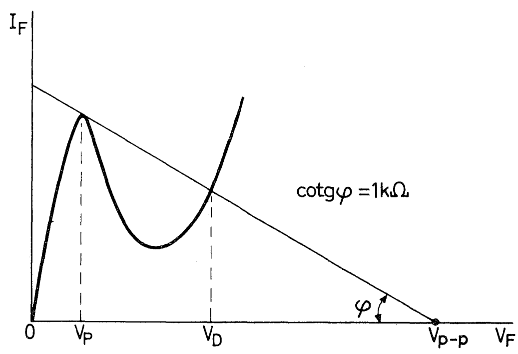
Test circuit:

	$V_{p\text{-}p}$
AEY23	1 V
AEY24	2.5 V
AEY25	4.7 V
AEY26	5 V
AEY27	10 V
AEY28	20 V



Definition of rise time





Variable capacitance diodes

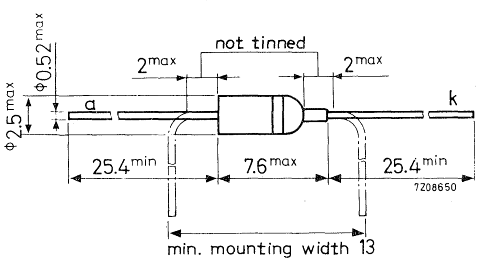
VOLTAGE DEPENDENT CAPACITOR

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 coloured band indicates the cathode

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

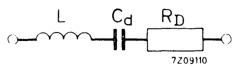
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	^oC/mW

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

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

Reverse current at $T_j = 80\ ^{o}C$ $V_R = 20$ 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 $f \leqq 300$ 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



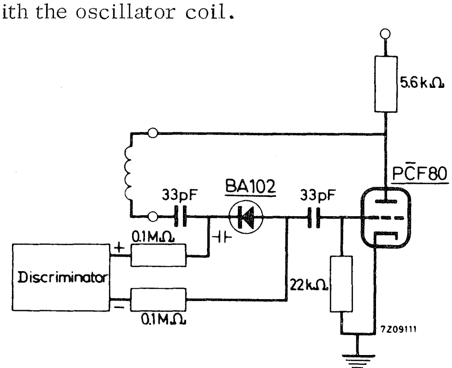
L = lead inductance ≈ 6 nH
r_D = series resistance
C_d = diode capacitance (see page 3)

} frequency independent up to f = 300 MHz

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

APPLICATION INFORMATION

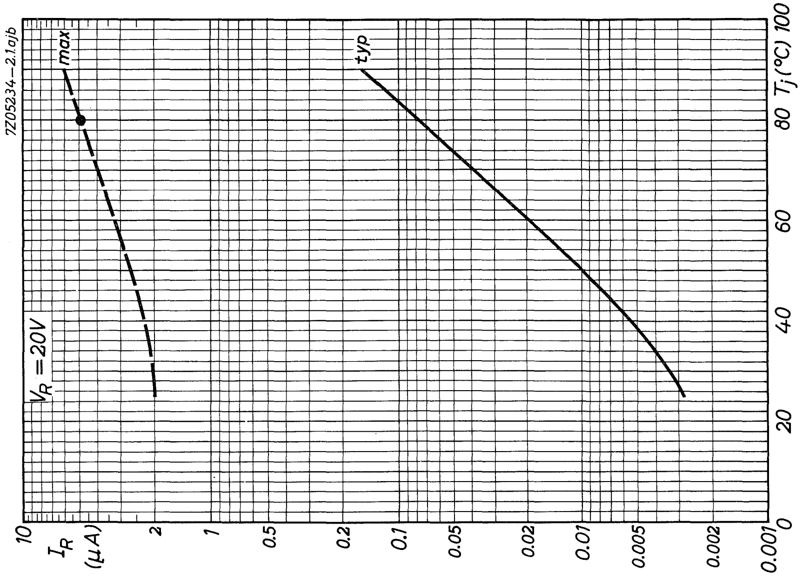
Basic circuit for automatic frequency control in television receivers using the BA102 in series with the oscillator coil.

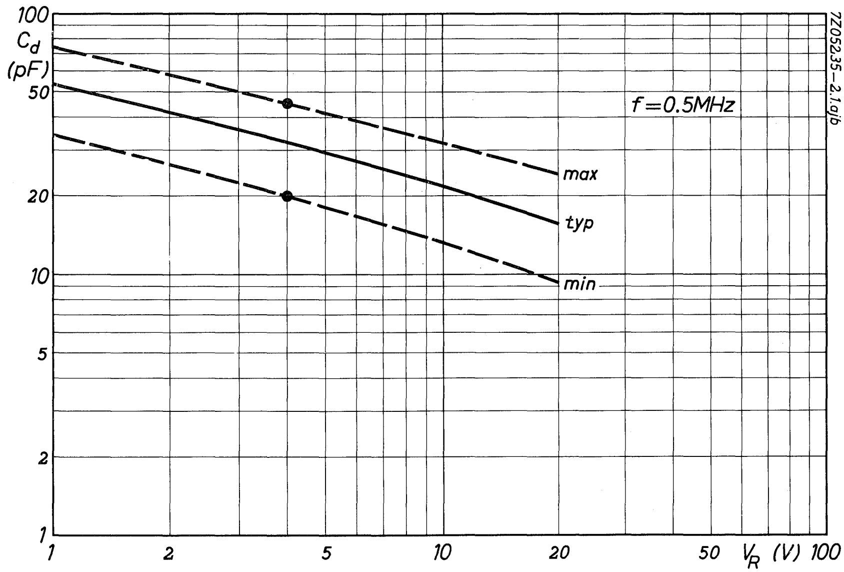


Sensitivity of the discriminator	:	25	V/MHz
Reduction of the frequency deviation Band I	:	1:10	
Band III	:	1:25	

[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; $T_j = 25\ ^{o}C$

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


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


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

SILICON PLANAR VARIABLE CAPACITANCE DIODES

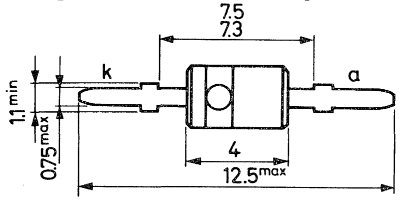
The BB105A is intended for use in u.h.f. tuners up to frequencies of 790 MHz.
The BB105B is meant for u.h.f. tuners up to frequencies of 860 MHz.
The BB105G is meant for v.h.f. tuners.
Twelve matched diodes are delivered together, thus containing 4 triplets or 3 quadruplets.
The capacitance difference between any two of the twelve diodes is less than 3% for the BB105A and BB105B and less than 6% for the BB105G over the voltage range from 0.5 to 28 V.

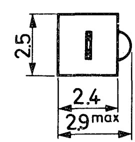
QUICK REFERENCE DATA

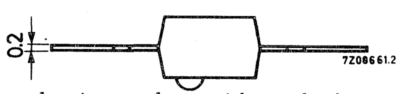
Reverse voltage		V_R	max.	28		V
Reverse current at V_R = 28 V		I_R	<	100		nA
			BB105A	BB105B	BB105G	
Diode capacitance at f = 1 MHz, V_R = 25 V		C_d	> 2.3	2.0	1.8	pF
			< 2.8	2.3	2.8	pF
Capacitance ratio at f = 1 MHz	$\frac{C_d(V_R = 3\ V)}{C_d(V_R = 25\ V)}$		> 4	4.5	4	
			< 5	6	6	
Series resistance at f = 470 MHz, V_R is that value at which C_d = 9 pF		r_D	typ. 0.6	0.7	0.9	Ω
			< 0.8	0.8	1.2	Ω

MECHANICAL DATA Dimensions in mm

12-BB105A and B: marked on packing
12-BB105G : green dot on the envelope







The white band indicates the cathode side

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

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

Continuous reverse voltage	V_R	max.	28	V
Reverse voltage (peak value)	V_{RM}	max.	30	V
Forward current (d.c.)	I_F	max.	20	mA
Storage temperature	T_{stg}		−55 to +60	°C
Junction temperature	T_j	max.	60	°C

THERMAL RESISTANCE

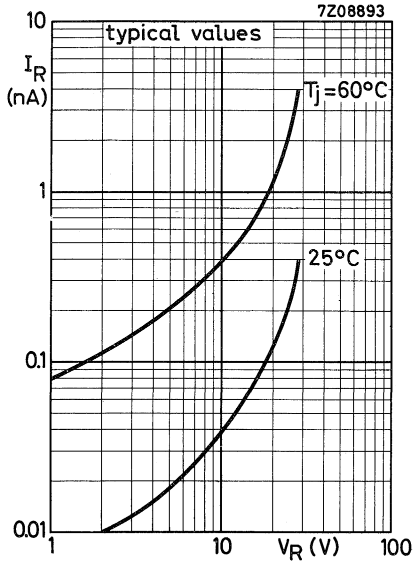
From junction to ambient in free air $R_{th\ j\text{-}a}$ = 0.4 °C/mW

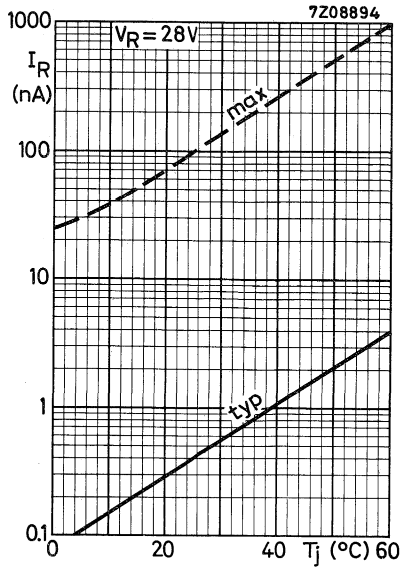
CHARACTERISTICS T_j = 25 °C unless otherwise specified

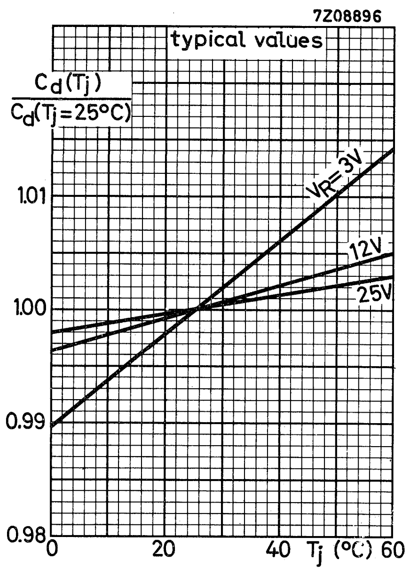
			BB105A	BB105B	BB105G	
Reverse current						
V_R = 28 V	I_R	<	100	100	100	nA
V_R = 28 V; T_j = 60 °C	I_R	<	1	1	1	μA
Diode capacitance at f = 1 MHz						
V_R = 1 V	C_d	typ.	17	17.5	17.5	pF
V_R = 3 V	C_d	typ.	11.5	11.5	11.5	pF
V_R = 25 V	C_d	>	2.3	2.0	1.8	pF
		<	2.8	2.3	2.8	pF
Capacitance ratio at f = 1 MHz	$\frac{C_d(V_R = 3\ V)}{C_d(V_R = 25\ V)}$	>	4	4.5	4	
		<	5	6	6	
Series resistance						
at f = 470 MHz and at that value of V_R at which C_d = 9 pF	r_D	typ.	0.6	0.7	0.9	Ω
		<	0.8	0.8	1.2	Ω
at f = 200 MHz and I_F = 5 mA	r_D	typ.	0.4	0.4	0.4	Ω

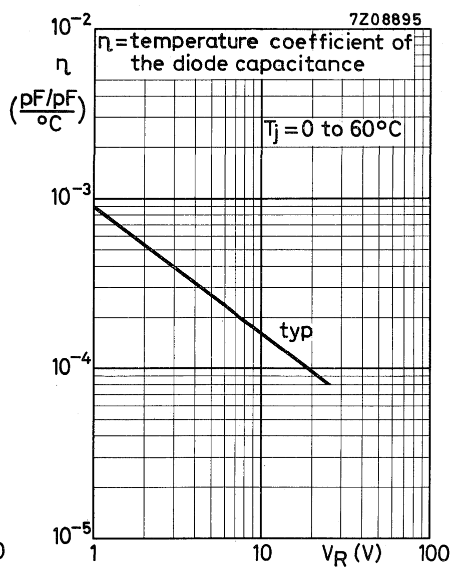
SOLDERING AND MOUNTING NOTES

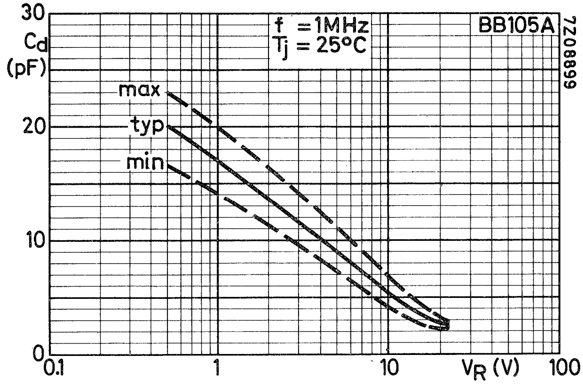
1. Soldered joints may be at any distance from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125 °C.
4. Leads should not be bent less than 0.5 mm from the seal; exert no axial pull when bending.

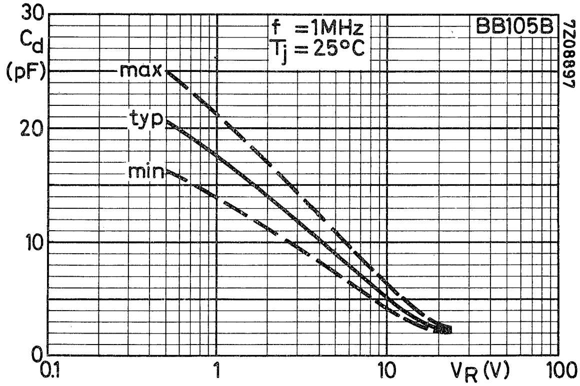

7Z08893
typical values
I_R (nA)
T_j = 60°C
25°C
V_R (V)
10
1
0.1
0.01
1
10
100

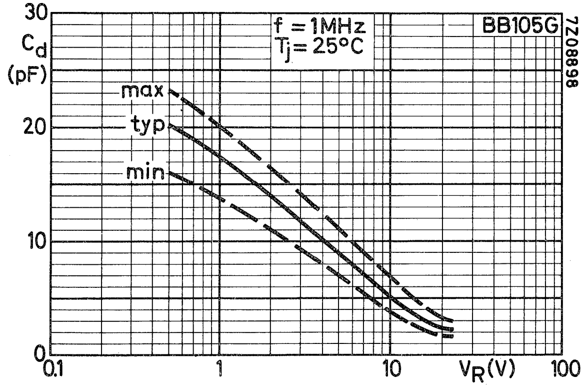

7Z08894
V_R = 28V
I_R (nA)
max
typ
T_j (°C)
1000
100
10
1
0.1
0
20
40
60


7Z08896
typical values
$\frac{C_d(T_j)}{C_d(T_j = 25°C)}$
V_R = 3V
12V
25V
T_j (°C)
1.01
1.00
0.99
0.98
0
20
40
60


7Z08895
η = temperature coefficient of the diode capacitance
η $\left(\frac{pF/pF}{°C}\right)$
T_j = 0 to 60°C
typ
V_R (V)
10^{-2}
10^{-3}
10^{-4}
10^{-5}
1
10
100


30
C_d
(pF)
20
10
0
0.1
1
10
V_R (V)
100
f = 1MHz
T_j = 25°C
BB105A
7Z08899
max
typ
min


30
C_d
(pF)
20
10
0
0.1
1
10
V_R (V)
100
f = 1MHz
T_j = 25°C
BB105B
7Z08897
max
typ
min


30
C_d
(pF)
20
10
0
0.1
1
10
V_R(V)
100
f = 1MHz
T_j = 25°C
BB105G
7Z08898
max
typ
min

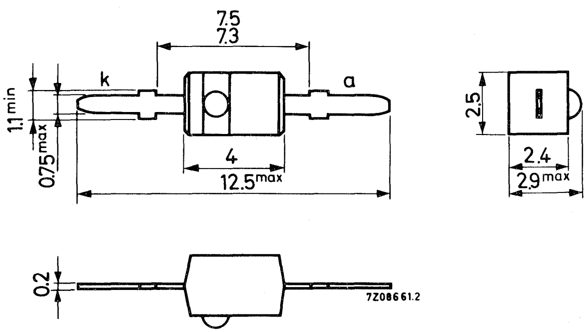
SILICON PLANAR VARIABLE CAPACITANCE DIODE

The 12-BB106 is a variable capacitance diode in a plastic envelope. The diode is primarily intended for electronic tuning in v.h.f. tuners with extended Band I (FCC norm). Twelve matched diodes are delivered together, thus containing 4 triplets or 3 quadruples. The matching is done at different voltages from 0.5 V to 28 V. In this range the capacitance difference between any two diodes of one group is less than 3%.

QUICK REFERENCE DATA

Diode capacitance at f = 0.5 MHz				
V_R = 3 V	C_d	>	20	pF
V_R = 25 V	C_d		4 to 5.6	pF
Capacitance ratio at f = 0.5 MHz	$\frac{C_d(V_R = 3\ V)}{C_d(V_R = 25\ V)}$		4.5 to 6.0	
Series resistance at f = 200 MHz				
V_R = that value at which C_d = 25 pF	r_D	typ.	0.4	Ω
		<	0.6	Ω

MECHANICAL DATA Dimensions in mm



The white band indicates the cathode

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

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

Voltages				
Continuous reverse voltage	V_R	max.	28	V
Reverse voltage (peak value)	V_{RM}	max.	30	V
Current				
Forward current (d.c.)	I_F	max.	20	mA
Temperatures				
Storage temperature	T_{stg}		−55 to +100	^oC
Junction temperature	T_j	max.	60	^oC

THERMAL RESISTANCE

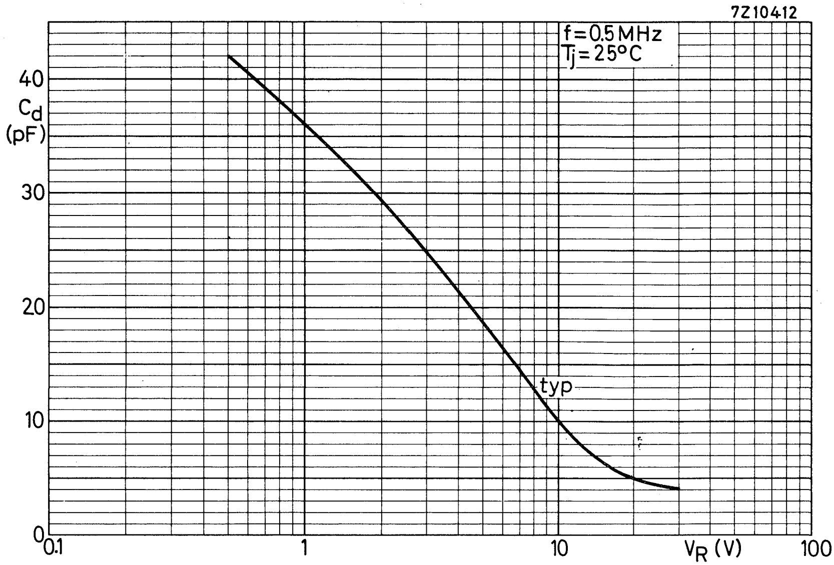
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	400	$^oC/W$

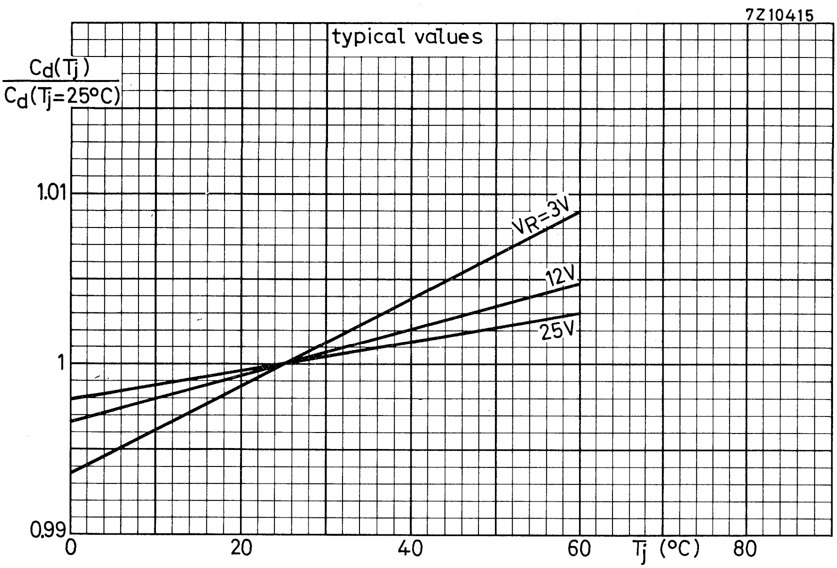
CHARACTERISTICS

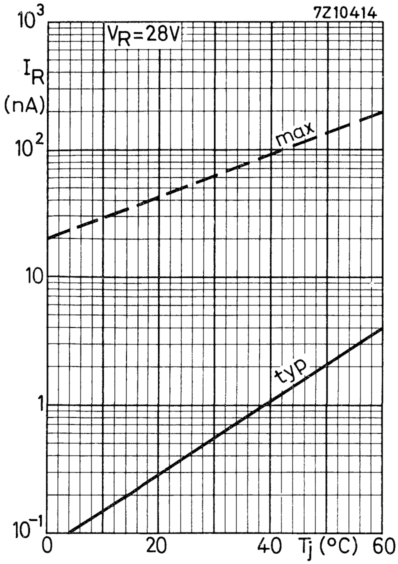
Reverse current at V_R = 28 V; T_j = 25 ^oC	I_R	<	50	nA
V_R = 28 V; T_j = 60 ^oC	I_R	<	200	nA
Series resistance at f = 200 MHz				
V_R = that value at which C_d = 25 pF	r_D	typ.	0.4	Ω
		<	0.6	Ω
Diode capacitance at f = 0.5 MHz				
V_R = 3 V	C_d	>	20	pF
V_R = 25 V	C_d		4 to 5.6	pF
Capacitance ratio at f = 0.5 MHz	$\frac{C_d(V_R = 3\ V)}{C_d(V_R = 25\ V)}$		4.5 to 6.0	

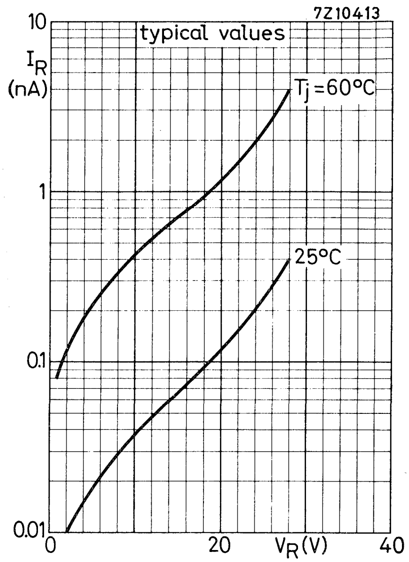
SOLDERING AND MOUNTING NOTES

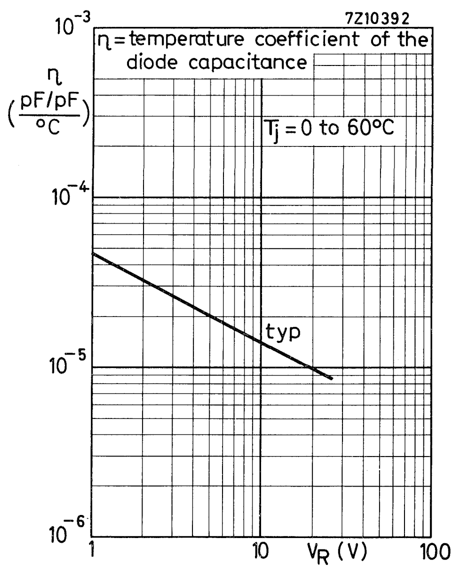
1. Soldered joints may be at any distance from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 ^oC; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125 ^oC.
4. Leads should not be bent less than 0.5 mm from the seal; exert no axial pull when bending.


7Z10412
f = 0.5 MHz
Tj = 25°C
40
Cd
(pF)
30
20
10
0
typ
0.1
1
10
VR (V)
100


7Z10415
typical values
Cd(Tj)
Cd(Tj=25°C)
1.01
1
0.99
VR=3V
12V
25V
0
20
40
60
Tj (°C)
80


7Z10414
$V_R = 28V$
I_R (nA)
max
typ
T_j (°C)


7Z10413
typical values
I_R (nA)
$T_j = 60°C$
25°C
V_R (V)


7Z10392
η = temperature coefficient of the diode capacitance
η (pF/pF / °C)
$T_j = 0$ to 60°C
typ
V_R (V)

Voltage regulator diodes

TYPE SELECTION CHART

Reference voltage ±5% V_Z (V)	400mW DO-7 glass	400mW DO-35 glass	400mW DO-7 glass	1W DO-15 plastic	1.5W DO-1 metal
	BZX75 *)				
1.4	–C1V4				
2.1	–C2V1				
2.8	–C2V8				
3.3	–		–C3V3		
3.6	–C3V6				
3.9					
4.3					
4.7		–C4V7			–C4V7
5.1					
5.6					
6.2					**BZY96series**
6.8					
7.5				–C7V5	
8.2					
9.1			**BZY88series**		–C9V1
10					–C10
11					
12					
13					
15					
16					
18		**BZX79series**			
20					
22					
24				**BZX61series**	
27					**BZY95series**
30			–C30		
33					
36					
39					
43					
47					
51					
56					
62					
68					
75		–C75		–C75	–C75

*) stabistors

Reference voltage ± 5 % V_Z (V)	1.5 W DO-15 plastic	2.5 W plastic	10 W DO-4 metal	20 W DO-4 metal	75 W DO-5 metal
5.6	-C5V6		BZZ14	Reverse polarity available	
6.2			BZZ15		
6.8			BZZ16		
7.5			BZZ17		-C7V5(R)
8.2			BZZ18		
9.1			BZZ19		
10		-C10	BZZ20	-C10(R)	
11			BZZ21		
12			BZZ22		
13			BZZ23		
15			BZZ24		
16			BZZ25		
18	BZX29series		BZZ26		
20			BZZ27		
22			BZZ28		
24			BZZ29		BZY93series
27		BZX70series			
30				BZY91series	
33					
36					
39					
43					
47					
51					
56	-C56				
62					
68					
75		-C75		-C75(R)	-C75(R)

Special diodes with extremely low temperature coefficient

Type	Temperature coefficient S_Z (%/°C)	Reference voltage V_Z (V)	Envelope
BZX48	0.001	6.5	TO-18 (2 leads)
BZX49	0.002	6.5	TO-18 (2 leads)
BZX50	0.005	6.5	TO-18 (2 leads)
BZY78	0.005	5.3	DO-7

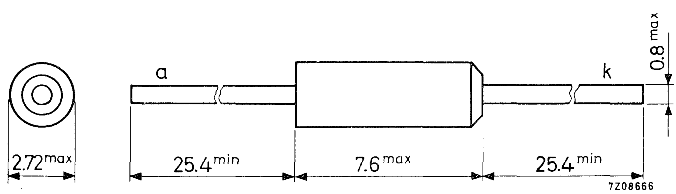
SILICON PLANAR VOLTAGE REFERENCE DIODES

Silicon planar voltage reference diodes in a miniature cylindrical DO-15 plastic envelope intended for stabilization purposes.
The series covers the whole normalized range of nominal zener voltages from 5.6 V to 56 V with a tolerance of ± 5%.

QUICK REFERENCE DATA				
Zener voltage range		nom.	5.6 to 56	V
Zener voltage tolerance			± 5	%
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5	W
Repetitive peak reverse power dissipation (square wave)	P_{ZRM}	max.	7.5	W
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	100	°C/W

MECHANICAL DATA Dimensions in mm

DO-15



The coned end indicates the cathode

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

Repetitive peak forward current	I_{FRM}	max.	400	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5	W
Repetitive peak reverse power dissipation (square wave) t = 100 ms; δ = 0.001; T_{amb} = 25 °C	P_{ZRM}	max.	7.5	W
Storage temperature	T_{stg}	-65 to +175		°C
Junction temperature	T_j	max.	175	°C

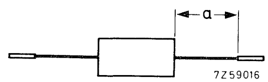
THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j-a}$

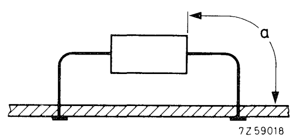
The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a = 5 mm. $R_{th\ j-a}$ = 100 °C/W

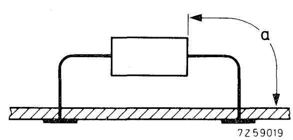
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 135 °C/W



3. Mounted on printed-wiring board with a small area of copper (< 0.25 cm^2) at any lead length **a**. $R_{th\ j-a}$ = 150 °C/W



4. Mounted on printed-wiring board with a large area of copper (≥ 1.5 cm^2) at any lead length **a**. $R_{th\ j-a}$ = 80 °C/W



SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.

2. The maximum permissible temperature of the soldering iron or bath is 300 °C ; it must be in contact with the joint for no more than 3 seconds.

3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 200 mA V_F < 1.5 V

Reverse current at		BZX29-C5V6 to C6V2	C6V8 to C10	C11 to C56	
V_R = 2 V	I_R	< 10			μA
$V_R = \frac{2}{3} \cdot V_{Znom}$	I_R	<	10	5	μA

Zener voltage V_Z

BZX29-	min.	nom.	max.	min.	typ.	typ.	max.
		at I_Z = 50 mA		at I_Z = 1 mA		at I_Z = 100 mA	
C5V6	5.3	5.6	6.0 V	4.4	5.1 V	5.9	6.5 V
C6V2	5.8	6.2	6.6 V	5.0	6.0 V	6.4	7.0 V
		at I_Z = 20 mA				at I_Z = 40 mA	
C6V8	6.4	6.8	7.2 V	5.6	6.6 V	6.9	7.5 V
C7V5	7.1	7.5	7.9 V	6.3	7.3 V	7.6	8.5 V
C8V2	7.7	8.2	8.7 V	6.8	8.0 V	8.4	9.0 V
C9V1	8.6	9.1	9.6 V	7.8	8.9 V	9.3	10.0 V
C10	9.4	10	10.6 V	8.5	9.9 V	10.2	11.0 V
C11	10.4	11	11.6 V	9.5	10.8 V	11.2	12.5 V
C12	11.4	12	12.6 V	10	11.5 V	12.5	13.5 V
C13	12.4	13	14.1 V	11	12.6 V	13.5	15.0 V
C15	13.9	15	15.6 V	12.5	14.5 V	15.5	16.5 V
		at I_Z = 10 mA		at I_Z = 0.25 mA		at I_Z = 20 mA	
C16	15.4	16	17.1 V	14	15.8 V	16.5	18 V
C18	16.9	18	19.1 V	15.5	17.5 V	18.5	20 V
C20	18.9	20	21.2 V	17.5	19.5 V	20.7	23 V
C22	20.8	22	23.3 V	19.5	21.4 V	22.7	25 V
C24	22.7	24	25.9 V	21	23.3 V	24.8	28 V
C27	25.1	27	28.9 V	24	26.2 V	27.8	30 V
C30	28	30	32 V	26	29.2 V	30.8	34 V
		at I_Z = 5 mA				at I_Z = 10 mA	
C33	31	33	35 V	29	32.6 V	33.4	37 V
C36	34	36	38 V	32	35.6 V	36.5	40 V
C39	37	39	41 V	35	38.5 V	39.5	43 V
C43	40	43	45 V	38	42.5 V	43.5	48 V
C47	44	47	50 V	42	46.4 V	47.7	53 V
C51	48	51	54 V	46	50.4 V	51.8	57 V
C56	53	56	60 V	50	55.3 V	57	64 V

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

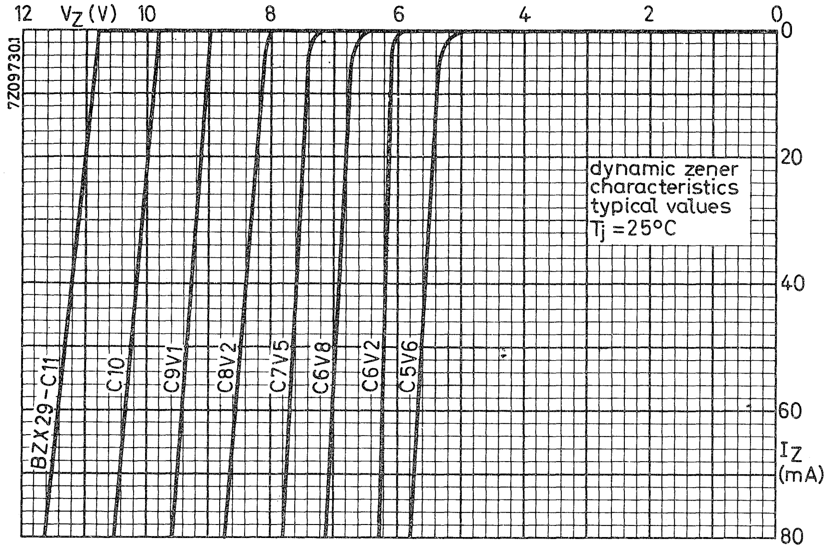
Differential resistance r_Z

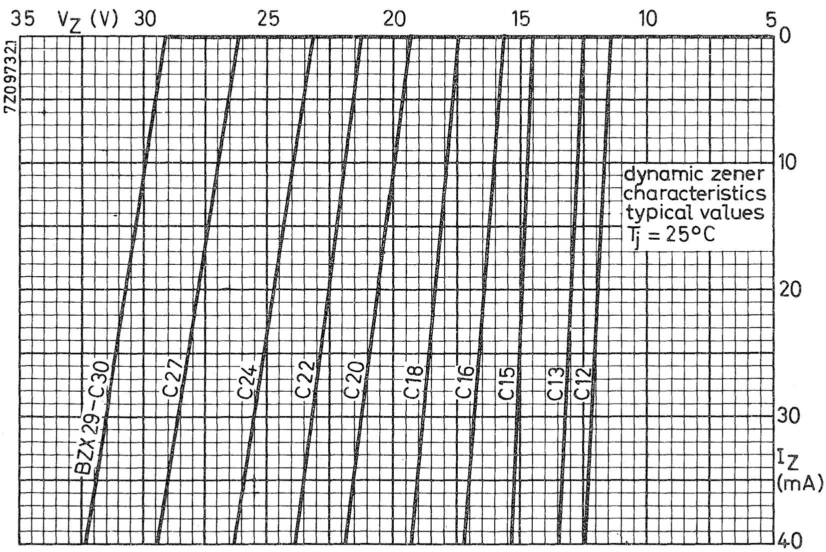
BZX29-	typ.	max.	typ.	max.	typ.	max.
	at I_Z = 50 mA		at I_Z = 1 mA		at I_Z = 100 mA	
C5V6	1.8	5 Ω	90	600 Ω	1.5	4 Ω
C6V2	0.7	2 Ω	15	700 Ω	0.6	1.5 Ω
	at I_Z = 20 mA				at I_Z = 40 mA	
C6V8	2.9	3.5 Ω	100	700 Ω	2.1	3.2 Ω
C7V5	3.0	4.4 Ω	100	700 Ω	2.2	3.5 Ω
C8V2	3.2	4.5 Ω	100	700 Ω	2.3	4.0 Ω
C9V1	3.5	5 Ω	110	700 Ω	2.5	4.5 Ω
C10	4	7 Ω	110	700 Ω	2.7	6 Ω
C11	5	8 Ω	120	700 Ω	3	7 Ω
C12	5	9 Ω	130	700 Ω	3	8 Ω
C13	5.5	10 Ω	140	700 Ω	3	9 Ω
C15	7	14 Ω	150	700 Ω	4.5	12 Ω
	at I_Z = 10 mA		at I_Z = 0.25 mA		at I_Z = 20 mA	
C16	10	16 Ω	200	700 Ω	7	14 Ω
C18	13	20 Ω	250	750 Ω	9	18 Ω
C20	15	22 Ω	300	750 Ω	10	20 Ω
C22	16	23 Ω	350	750 Ω	11	22 Ω
C24	20	25 Ω	400	750 Ω	16	24 Ω
C27	23	35 Ω	420	750 Ω	17	30 Ω
C30	24	40 Ω	450	1000 Ω	18	35 Ω
	at I_Z = 5 mA				at I_Z = 10 mA	
C33	38	45 Ω	500	1000 Ω	22	40 Ω
C36	40	50 Ω	700	1000 Ω	25	45 Ω
C39	42	60 Ω	750	1000 Ω	27	50 Ω
C43	45	70 Ω	800	1500 Ω	30	60 Ω
C47	50	80 Ω	900	1500 Ω	35	70 Ω
C51	60	95 Ω	1000	1500 Ω	40	80 Ω
C56	65	110 Ω	1100	2000 Ω	45	90 Ω

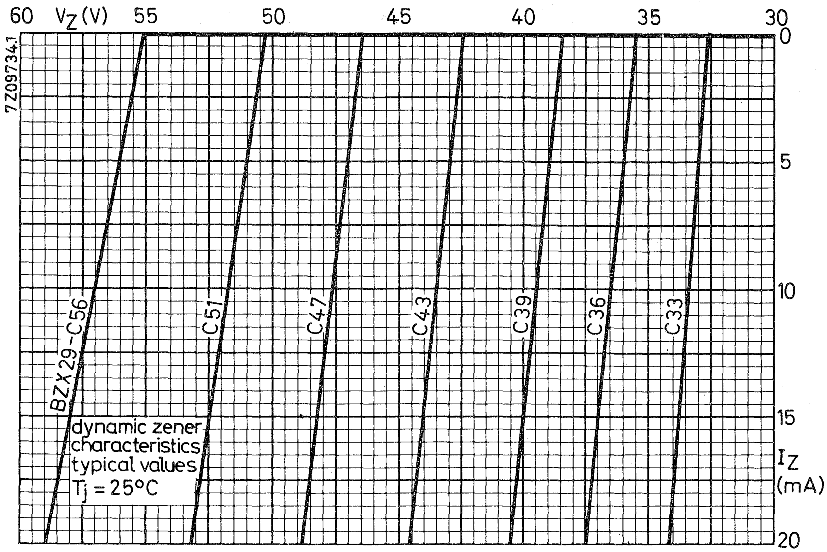
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

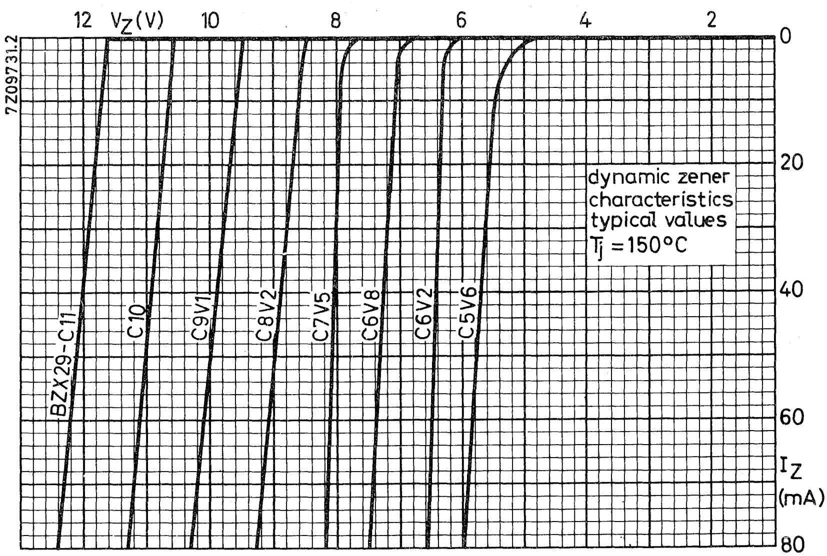
Temperature coefficient S_Z and diode capacitance C_d

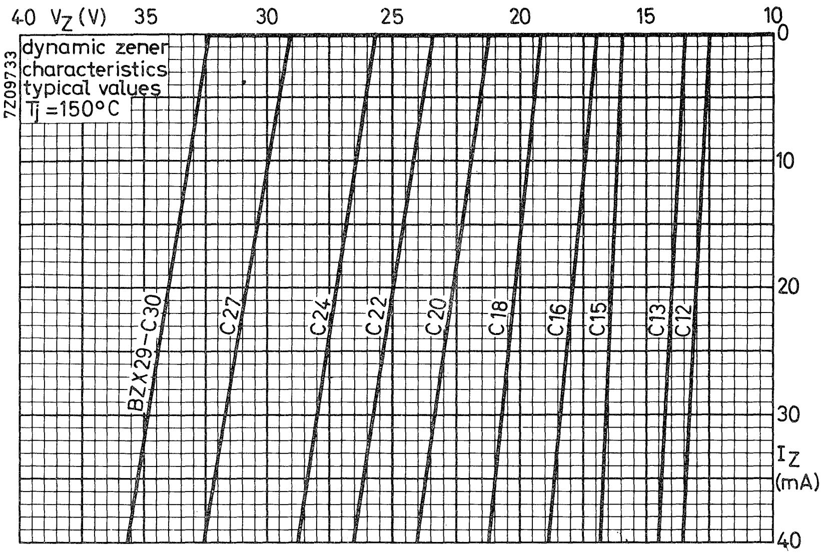
BZX29-	S_Z typ.	S_Z typ.	S_Z typ.	C_d typ.
	at I_Z = 50 mA	at I_Z = 1 mA	at I_Z = 100 mA	at V_R = 2 V
C5V6	+1.1 mV/°C	-0.6 mV/°C	+2.0 mV/°C	700 pF
C6V2	+2.2 mV/°C	+1.6 mV/°C	+2.2 mV/°C	700 pF
	at I_Z = 20 mA		at I_Z = 40 mA	
C6V8	+2.7 mV/°C	+2.2 mV/°C	+2.7 mV/°C	700 pF
C7V5	+3.4 mV/°C	+3.4 mV/°C	+3.4 mV/°C	480 pF
C8V2	+3.9 mV/°C	+3.9 mV/°C	+3.9 mV/°C	480 pF
C9V1	+4.65 mV/°C	+4.63 mV/°C	+4.65 mV/°C	380 pF
C10	+5.5 mV/°C	+5.5 mV/°C	+5.5 mV/°C	380 pF
C11	+6.6 mV/°C	+6.6 mV/°C	+6.6 mV/°C	320 pF
C12	+7.8 mV/°C	+7.8 mV/°C	+7.8 mV/°C	310 pF
C13	+8.45 mV/°C	+8.45 mV/°C	+8.45 mV/°C	280 pF
C15	+10.5 mV/°C	+10.5 mV/°C	+10.5 mV/°C	240 pF
	at I_Z = 10 mA	at I_Z = 0.25 mA	at I_Z = 20 mA	
C16	+11.2 mV/°C	+11.2 mV/°C	+11.2 mV/°C	210 pF
C18	+13.5 mV/°C	+13.5 mV/°C	+13.5 mV/°C	200 pF
C20	+15.0 mV/°C	+13.5 mV/°C	+15.0 mV/°C	180 pF
C22	+17.6 mV/°C	+17.6 mV/°C	+17.6 mV/°C	170 pF
C24	+19.2 mV/°C	+19.2 mV/°C	+19.2 mV/°C	160 pF
C27	+23.0 mV/°C	+23.0 mV/°C	+23.0 mV/°C	150 pF
C30	+25.5 mV/°C	+25.5 mV/°C	+25.5 mV/°C	130 pF
	at I_Z = 5 mA		at I_Z = 10 mA	
C33	+28.0 mV/°C	+28.0 mV/°C	+28.0 mV/°C	120 pF
C36	+30.5 mV/°C	+30.5 mV/°C	+30.5 mV/°C	120 pF
C39	+35.0 mV/°C	+35.0 mV/°C	+35.0 mV/°C	110 pF
C43	+38.5 mV/°C	+38.5 mV/°C	+38.5 mV/°C	100 pF
C47	+42.5 mV/°C	+42.5 mV/°C	+42.5 mV/°C	100 pF
C51	+46.0 mV/°C	+46.0 mV/°C	+46.0 mV/°C	90 pF
C56	+50.5 mV/°C	+50.5 mV/°C	+50.5 mV/°C	85 pF

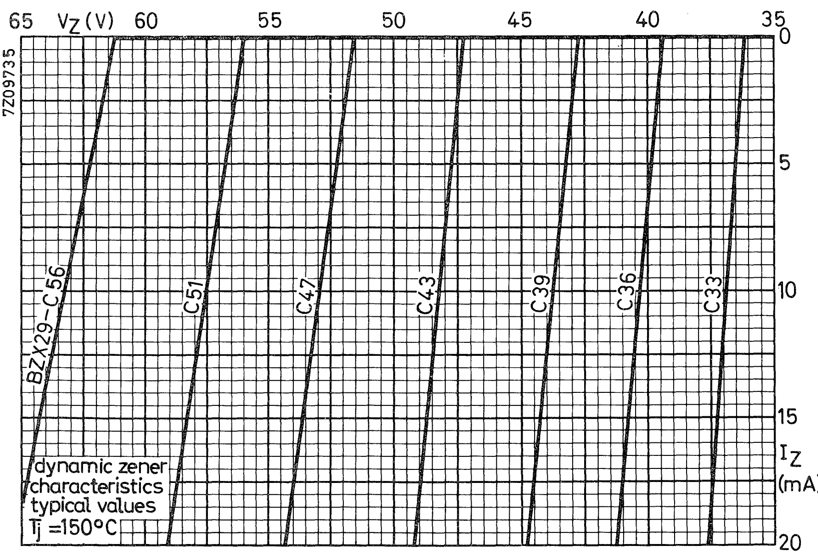

7Z09730.1
12
V_Z (V)
10
8
6
4
2
0
0
20
40
60
80
I_Z (mA)
dynamic zener characteristics typical values T_j = 25°C
BZX29-C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6

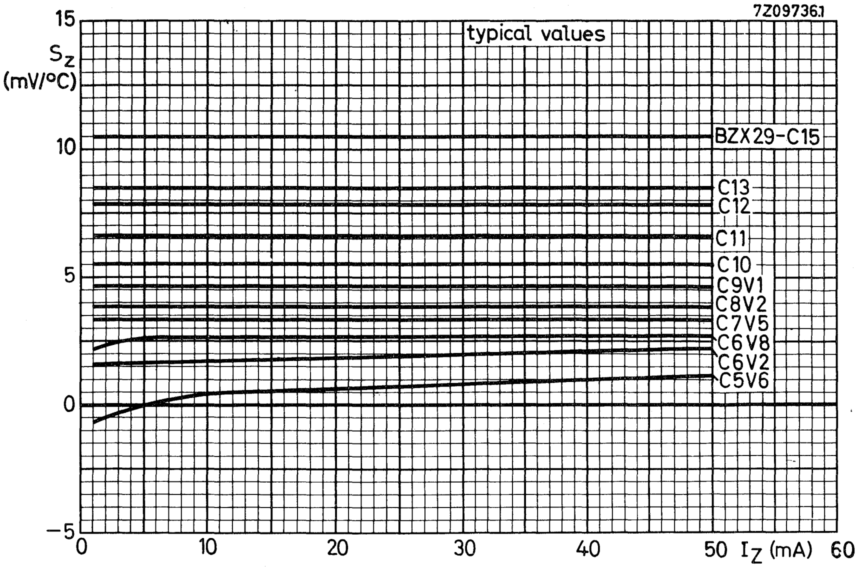

7Z09732.1
35
V_Z (V)
30
25
20
15
10
5
0
10
20
30
40
I_Z (mA)
dynamic zener characteristics typical values T_j = 25°C
BZX29-C30
C27
C24
C22
C20
C18
C16
C15
C13
C12

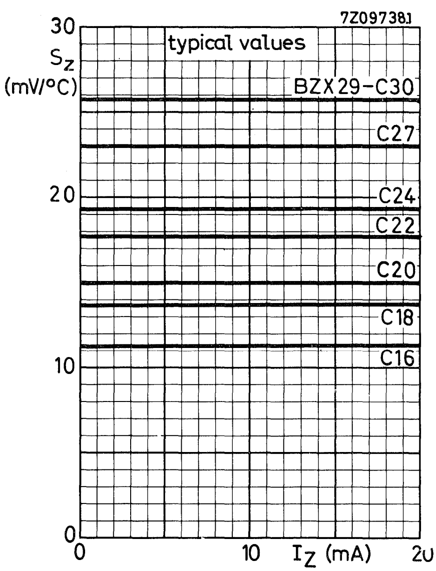

60
V_Z(V)
55
50
45
40
35
30
7Z09734.1
0
5
10
15
20
I_Z
(mA)
BZX29-C56
C51
C47
C43
C39
C36
C33
dynamic zener
characteristics
typical values
T_j = 25°C

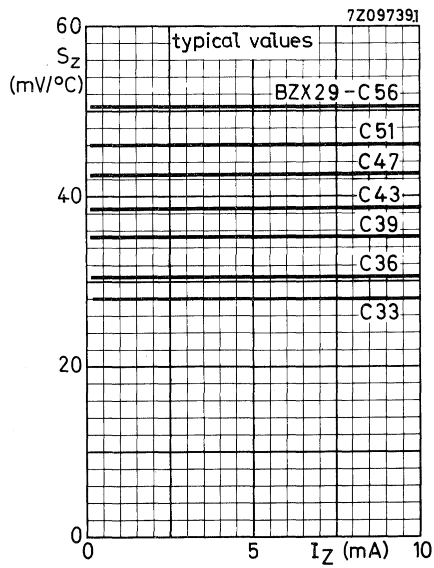

12
V_Z(V)
10
8
6
4
2
7Z09731.2
0
20
40
60
80
I_Z
(mA)
BZX29-C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
dynamic zener
characteristics
typical values
T_j = 150°C

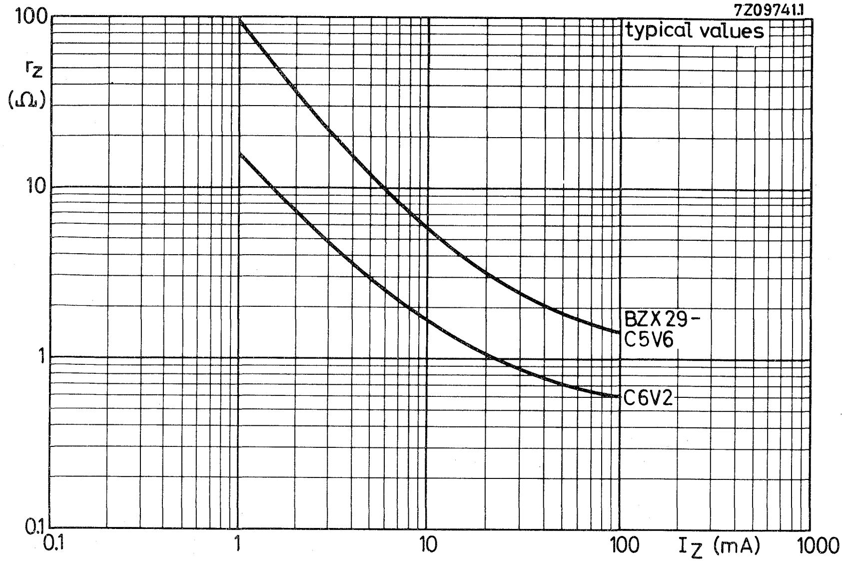

7Z09733
40 V_Z (V) 35 30 25 20 15 10
dynamic zener characteristics typical values T_j =150°C
BZX29–C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
0
10
20
30
40
I_Z (mA)

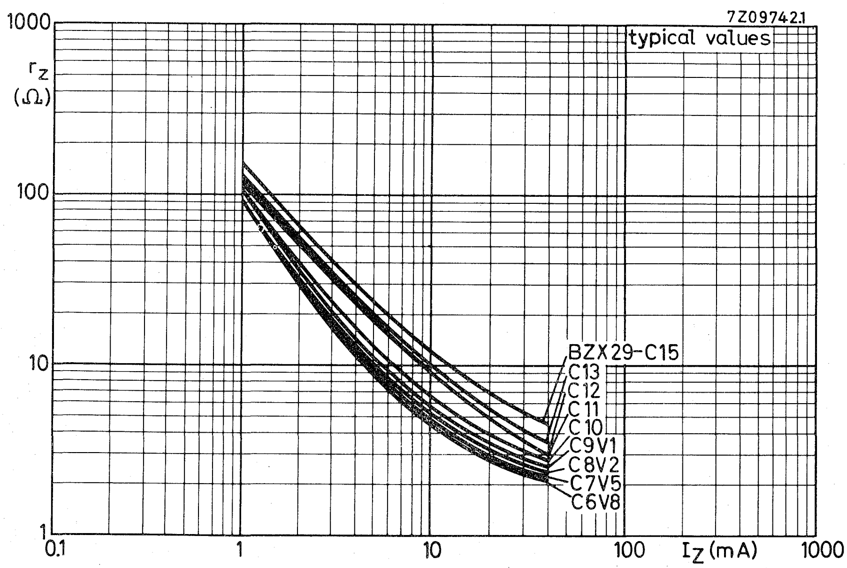

7Z09735
65 V_Z (V) 60 55 50 45 40 35
BZX29–C56
C51
C47
C43
C39
C36
C33
dynamic zener characteristics typical values T_j =150°C
0
5
10
15
20
I_Z (mA)

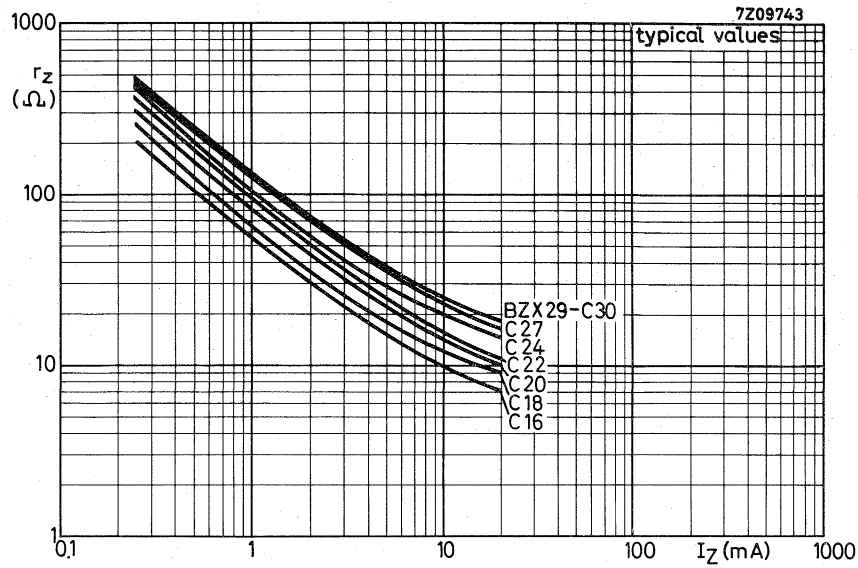

7Z09736.1
typical values
15
S_Z
(mV/°C)
10
5
0
−5
BZX29-C15
C13
C12
C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
0
10
20
30
40
50
I_Z (mA)
60

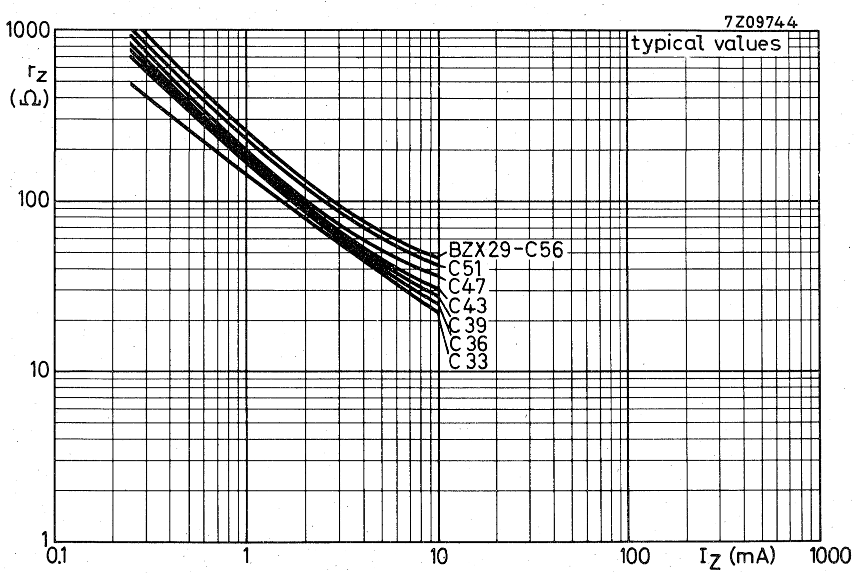

7Z09738.1
typical values
30
S_Z
(mV/°C)
20
10
0
BZX29-C30
C27
C24
C22
C20
C18
C16
0
10
I_Z (mA)
20

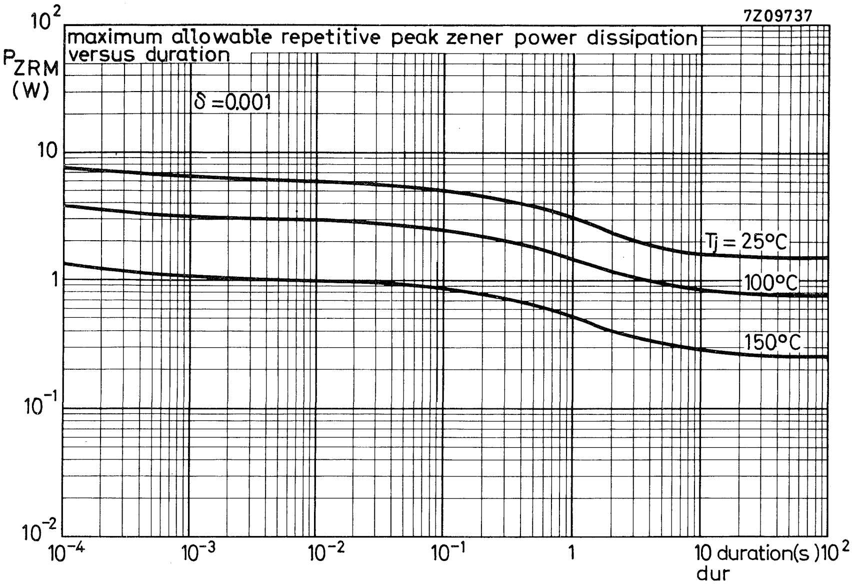

7Z09739.1
typical values
60
S_Z
(mV/°C)
40
20
0
BZX29-C56
C51
C47
C43
C39
C36
C33
0
5
I_Z (mA)
10

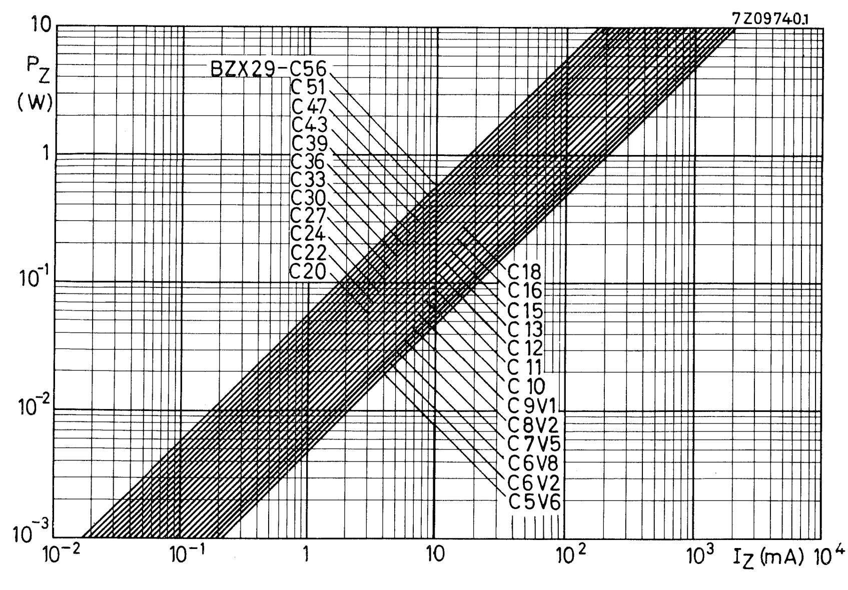

7Z09741.1
typical values
r_Z (Ω)
100
10
1
0.1
0.1
1
10
100
I_Z (mA)
1000
BZX 29-C5V6
C6V2

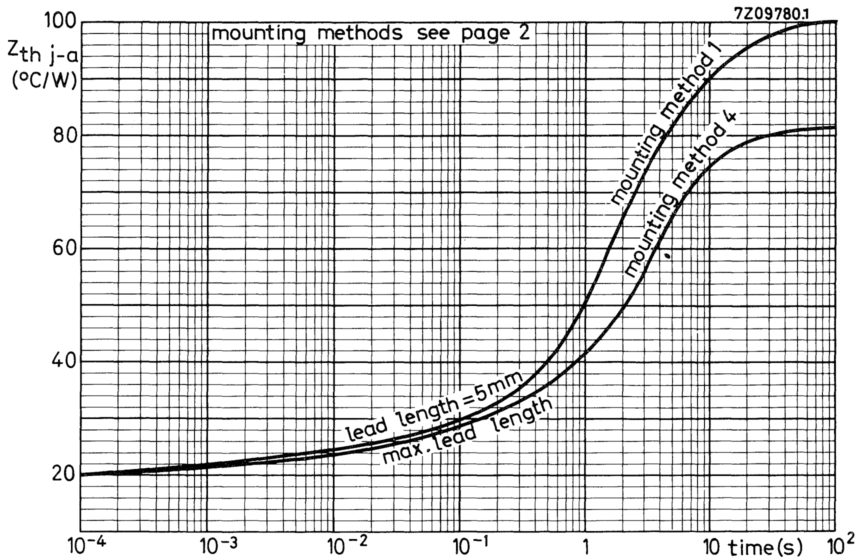

7Z09742.1
typical values
r_Z (Ω)
1000
100
10
1
0.1
1
10
100
I_Z (mA)
1000
BZX 29-C15
C13
C12
C11
C10
C9V1
C8V2
C7V5
C6V8


7Z09743
typical values
1000
r_Z
(Ω)
100
10
1
0.1
1
10
100
I_Z (mA)
1000
BZX29-C30
C27
C24
C22
C20
C18
C16


7Z09744
typical values
1000
r_Z
(Ω)
100
10
1
0.1
1
10
100
I_Z (mA)
1000
BZX29-C56
C51
C47
C43
C39
C36
C33


7Z09737
maximum allowable repetitive peak zener power dissipation
versus duration
P_{ZRM}
(W)
δ =0.001
T_j = 25°C
100°C
150°C
duration(s)
dur


7Z09740.1
P_Z
(W)
BZX29-C56
C51
C47
C43
C39
C36
C33
C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
I_Z (mA)


7Z09780.1
100
$Z_{th\ j\text{-}a}$ (°C/W)
80
60
40
20
mounting methods see page 2
mounting method 1
mounting method 4
lead length = 5 mm
max. lead length
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10 time (s)
10^{2}

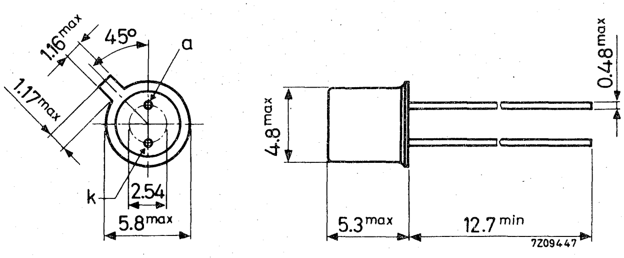
VOLTAGE REFERENCE DIODES

Silicon planar voltage reference diodes in a metal envelope. They have a very low temperature coefficient and are primarily intended for use as reference sources in in measurement equipment such as digital voltmeters.

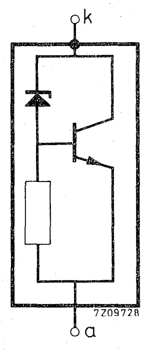
QUICK REFERENCE DATA				
Zener voltage at I_Z = 2.0 mA	V_Z	nom.	6.5	V
Zener voltage tolerance			± 5	%
Temperature coefficient at I_Z = 2.0 mA				
BZX48:	S_Z	<	+0.065	mV/°C
BZX49:	S_Z	<	+0.13	mV/°C
BZX50:	S_Z	<	+0.325	mV/°C
Recommended operating ambient temperature range	T_{amb}		0 to +70	°C

MECHANICAL DATA Dimensions in mm

Except for the two leads only, conforming to TO-18



Cathode connected to case



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

Currents

Zener current (d.c.)	I_Z	max.	10	mA
Zener current (peak value)	I_{ZM}	max.	10	mA

Temperatures

Storage temperature	T_{stg}	-65 to +150	°C
Operating ambient temperature	T_{amb}	-65 to +100	°C

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

Zener voltage at

I_Z = 1.0 mA	V_Z	typ.	6.42	V
I_Z = 2.0 mA	V_Z	typ.	6.45	V
		6.1 to	6.9	V
I_Z = 3.0 mA	V_Z	typ.	6.47	V

Reverse current at V_R = 4.0 V	I_R	typ.	0.1	μA
		<	1.0	μA

Temperature coefficient at I_Z = 2.0 mA

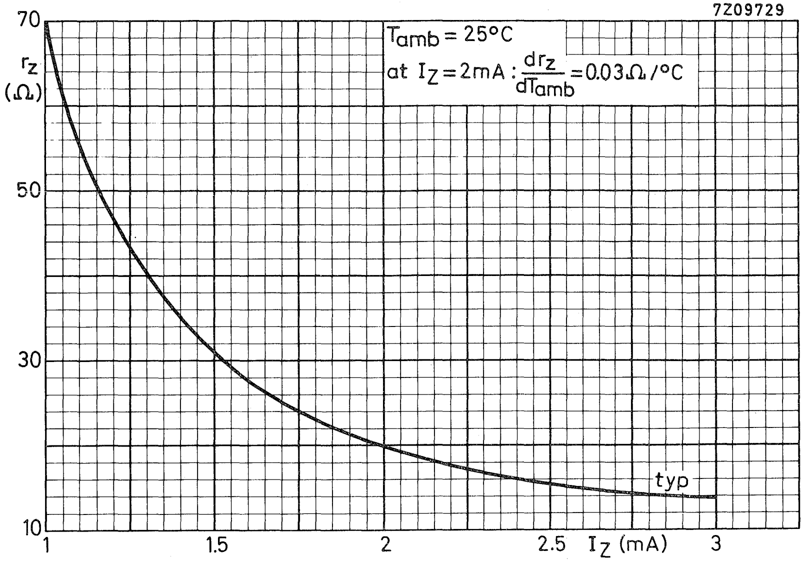
T_{amb} = 0 to 70 °C	BZX48:	S_Z	<	+0.065	mV/°C
	BZX49:	S_Z	<	+0.13	mV/°C
	BZX50:	S_Z	<	+0.325	mV/°C
I_Z = 1 to 3 mA					
	BZX48:	S_Z	<	+0.13	mV/°C
	BZX49:	S_Z	<	+0.325	mV/°C
	BZX50:	S_Z	<	+0.65	mV/°C

Differential resistance at I_Z = 1.0 mA	r_Z	typ.	70	Ω
		<	125	Ω
I_Z = 2.0 mA	r_Z	typ.	20	Ω
		10 to	50	Ω
I_Z = 3.0 mA	r_Z	typ.	14	Ω
		<	25	Ω

OPERATING NOTES

Recommended operating temperature range T_{amb} = 0 to +70 °C
Optimum operating zener current $I_{Z\ opt}$ = 2.0 ± 5% mA.

The tolerance given is that which will not significantly affect the temperature coefficient. Changes due to differential resistance must still be taken into account.


7Z09729
$T_{amb} = 25°C$
at $I_Z = 2mA : \frac{dr_Z}{dT_{amb}} = 0.03\Omega/°C$
70
r_Z
(Ω)
50
30
10
typ
1
1.5
2
2.5
I_Z (mA)
3

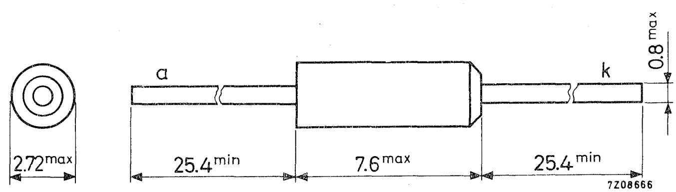
VOLTAGE REGULATOR DIODES

Silicon diodes in a DO-15 plastic envelope intended for general purpose use as low power voltage regulators.
The series consists of 26 types with nominal zener voltages ranging from 7.5 V to 75 V with a tolerance of ±5%.

QUICK REFERENCE DATA				
Zener voltage range		nom.	7.5 to 75	V
Zener voltage tolerance			±5	%
Peak zener current	I_{ZM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.15	°C/mW

MECHANICAL DATA Dimensions in mm

DO-15



The coned end indicates the cathode

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

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	1	A
Peak zener current	I_{ZM}	max.	3	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.15	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage

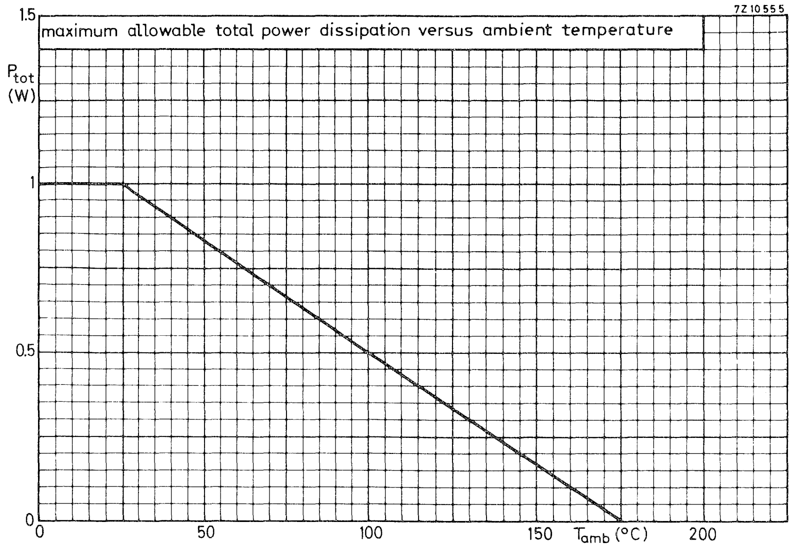
I_F = 100 mA; T_{amb} = 25 °C	V_F	typ.	0.86	V
		<	1.1	V

Reverse current

		BZX61-C7V5 to 8V2	C9V1	C10 to C75	
V_R = 3 V	I_R	< 10	-	-	μA
V_R = 5 V	I_R	< -	10	-	μA
$V_R = \frac{2}{3} \cdot V_{Z\,nom}$	I_R	< -	-	5	μA

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

BZX61-...	Zener voltage V_Z at I_Z = 20 mA			Temperature coefficient at I_Z = 20 mA	Differential resistance at I_Z = 20 mA
	min.	nom.	max.	typ.	max.
C7V5	7.1	7.5	7.9 V	+3.0 mV/°C	6.0 Ω
C8V2	7.8	8.2	8.7 V	+3.3 mV/°C	7.5 Ω
C9V1	8.6	9.1	9.6 V	+4.6 mV/°C	8.0 Ω
C10	9.4	10	10.6 V	+5.0 mV/°C	8.5 Ω
C11	10.4	11	11.6 V	+5.5 mV/°C	9.0 Ω
C12	11.4	12	12.6 V	+6.0 mV/°C	9.0 Ω
C13	12.4	13	14.1 V	+6.5 mV/°C	10 Ω
C15	13.9	15	15.6 V	+9.0 mV/°C	14 Ω
	at I_Z = 10 mA			at I_Z = 10 mA	at I_Z = 10 mA
	min.	nom.	max.	typ.	max.
C16	15.4	16	17.1 V	+10 mV/°C	16 Ω
C18	16.9	18	19.1 V	+11 mV/°C	20 Ω
C20	18.9	20	21.2 V	+12 mV/°C	22 Ω
C22	20.8	22	23.3 V	+13 mV/°C	23 Ω
C24	22.7	24	25.9 V	+14 mV/°C	25 Ω
C27	25.1	27	28.9 V	+16 mV/°C	35 Ω
C30	28	30	32 V	+21 mV/°C	40 Ω
C33	31	33	35 V	+23 mV/°C	45 Ω
C36	34	36	38 V	+25 mV/°C	50 Ω
	at I_Z = 5 mA			at I_Z = 5 mA	at I_Z = 5 mA
	min.	nom.	max.	typ.	max.
C39	37	39	41 V	+27 mV/°C	60 Ω
C43	40	43	45 V	+30 mV/°C	70 Ω
C47	44	47	50 V	+38 mV/°C	80 Ω
C51	48	51	54 V	+41 mV/°C	95 Ω
C56	53	56	60 V	+45 mV/°C	105 Ω
C62	58	62	66 V	+50 mV/°C	110 Ω
C68	64	68	72 V	+54 mV/°C	120 Ω
C75	71	75	79 V	+60 mV/°C	135 Ω



SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.

2. The maximum permissible temperature of the soldering iron or bath is 245 °C; it must be in contact with the joint for no more than 5 seconds.

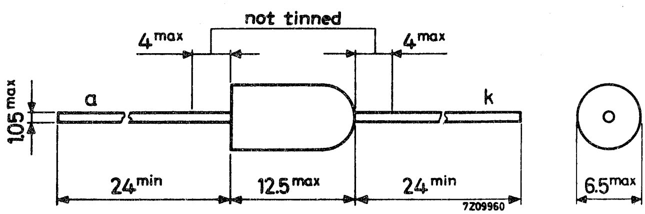
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 175 °C.

VOLTAGE REGULATOR DIODES

Silicon diodes in a plastic envelope for general purpose use as medium power voltage stabilizers or voltage references.
The series consist of 22 types with nominal zener voltages ranging from 10 V to 75 V with a tolerance of ±5%.

QUICK REFERENCE DATA				
Zener voltage range		nom.	10 to 75	V
Zener voltage tolerance			± 5	%
Repetitive peak zener current	I_{ZRM}	max.	5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	2.5	W
Non repetitive peak reverse power	P_{ZSM}	max.	100	W
Junction temperature	T_j	max.	150	°C
Thermal resistance from junction to ambient with 10 mm tie points on an infinite heatsink	$R_{th\ j\text{-}a}$	=	50	°C/W

MECHANICAL DATA Dimensions in mm



The rounded end indicates the cathode

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

MOUNTING METHODS see page 6.

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

Currents

Forward current (averaged over any 20 ms period)	I_{FAV}	max.	1	A
Repetitive peak forward current	I_{FRM}	max.	3	A
Repetitive peak zener current	I_{ZRM}	max.	5	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C with max. lead length; mounting method 2 (see pages 6 and 11)	P_{tot}	max.	1.75	W
with 10 mm tie points on infinite heatsink (see page 11)	P_{tot}	max.	2.5	W
Non repetitive peak reverse power	P_{ZSM}	max.	100	W

Temperatures

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

THERMAL RESISTANCE (see pages 6 and 11)

From junction to ambient

with max. lead length: mounting method 2	$R_{th\ j\text{-}a}$	=	70	°C/W
with 10 mm tie points: mounting method 1	$R_{th\ j\text{-}a}$	=	60	°C/W
with 10 mm tie points mounted on infinite heatsink	$R_{th\ j\text{-}a}$	=	50	°C/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 1.0 A — V_F < 1.5 V

Reverse current at $V_R = \frac{2}{3} \cdot V_{Z\,nom}$ — I_R < 10 µA

BZX70-...	Zener voltage V_Z at I_Z = 50 mA			Temperature coefficient S_Z at I_Z = 50 mA	Differential resistance r_Z at I_Z = 50 mA	
	min.	nom.	max.	typ.	typ.	max.
C10	9.4	10	10.6 V	7.0 mV/°C	0.75	4.0 Ω
C11	10.4	11	11.6 V	7.5 mV/°C	0.80	4.5 Ω
C12	11.4	12	12.6 V	8.0 mV/°C	0.85	5.0 Ω
C13	12.4	13	14.1 V	8.5 mV/°C	0.90	6.0 Ω
C15	13.9	15	15.6 V	10.0 mV/°C	1.0	8.0 Ω
	at I_Z = 20 mA			at I_Z = 20 mA	at I_Z = 20 mA	
	min.	nom.	max.	typ.	typ.	max.
C16	15.4	16	17.1 V	11 mV/°C	2.4	9 Ω
C18	16.9	18	19.1 V	12 mV/°C	2.5	11 Ω
C20	18.9	20	21.2 V	14 mV/°C	2.8	12 Ω
C22	20.8	22	23.3 V	16 mV/°C	3.0	13 Ω
C24	22.7	24	25.9 V	18 mV/°C	3.4	14 Ω
C27	25.1	27	28.9 V	20 mV/°C	3.8	18 Ω
C30	28	30	32 V	25 mV/°C	4.5	22 Ω
C33	31	33	35 V	30 mV/°C	5.0	25 Ω
C36	34	36	38 V	32 mV/°C	5.5	30 Ω
	at I_Z = 10 mA			at I_Z = 10 mA	at I_Z = 10 mA	
	min.	nom.	max.	typ.	typ.	max.
C39	37	39	41 V	35 mV/°C	12	35 Ω
C43	40	43	45 V	40 mV/°C	13	40 Ω
C47	44	47	50 V	45 mV/°C	14	50 Ω
C51	48	51	54 V	50 mV/°C	15	55 Ω
C56	53	56	60 V	55 mV/°C	17	63 Ω
C62	58	62	66 V	60 mV/°C	18	75 Ω
C68	64	68	72 V	65 mV/°C	18	90 Ω
C75	71	75	79 V	70 mV/°C	20	100 Ω

OPERATING NOTES

1. Dissipation and heatsink considerations

a. Steady-state conditions

The maximum allowable steady-state dissipation $P_{S\,max}$ 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 additional pulse power $P_{m\,max}$ is given by the formula

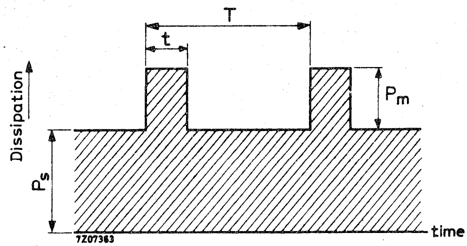
$$P_{m\,max} = \frac{(T_{j\,max} - T_{amb}) - (P_S \cdot R_{th\,j\text{-}a})}{Z_{th\,j\text{-}a}}$$

where P_S is the steady-state dissipation, excluding that in the pulses,
$Z_{th\,j\text{-}a}$ is the effective thermal impedance of the device from junction to ambient. It is a function of the pulse duration t and duty cycle δ (see page 10)

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 11, lower figure. With the additional pulsed power dissipation $P_{m\,max}$ calculated from the above expression, the total repetitive peak zener power dissipation $P_{ZRM} = P_S + P_{m\,max}$. From page 11, lower figure the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilization time of the diode t_{stab}, the maximum allowable repetitive peak dissipation P_{ZRM} is equal to the maximum steady-state power $P_{S\,max}$. The temperature stabilization time for the BZX70series is 100 s (see page 10).

OPERATING NOTES (continued)



Example

The following example illustrates how to calculate the maximum permissible repetitive peak zener current of a BZX70-C30 zener diode mounted on a printed circuit board with max. lead length at a maximum ambient temperature of 60 °C. The steady-state zener current is 25 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 25 mA (from page 11, lower figure) = 0.9 W.
The thermal resistance from junction to ambient $R_{th\ j\text{-}a} = 85\ ^oC/W$ (mounting method 3 on page 6).
The thermal impedance $Z_{th\ j\text{-}a}$ with a duty cycle $\delta = 0.1$ and a pulse duration $t = 1$ ms (from page 10, lower figure).

$$Z_{th\ j\text{-}a} = 9.2\ ^oC/W$$

The maximum additional pulse power dissipation

$$P_{m\ max} = \frac{(T_{j\ max} - T_{amb}) - P_S \cdot R_{th\ j\text{-}a}}{Z_{th\ j\text{-}a}}$$

If $P_S = 0.9$ W, $Z_{th\ j\text{-}a} = 9.2\ ^oC/W$

$$P_{m\ max} = \frac{(150-60) - (0.9 \text{x} 85)}{9.2} = 1.47 \text{ W}$$

therefore, the total repetitive peak power dissipation,

$$P_{ZRM} = 0.9 + 1.47 = 2.37 \text{ W}$$

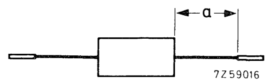
From page 11, lower figure, the corresponding repetitive peak zener current is 65 mA. This is within the rating of the BZX70-C30 and is therefore permissible.

THERMAL RESISTANCE

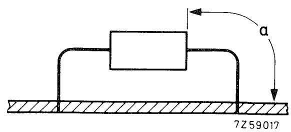
Effect of mounting on thermal resistance $R_{th\ j-a}$

The quoted values apply when no other leads run to the tie–points. If leads of other dissipating components share the same tie–points, the thermal resistance will be higher than that quoted.

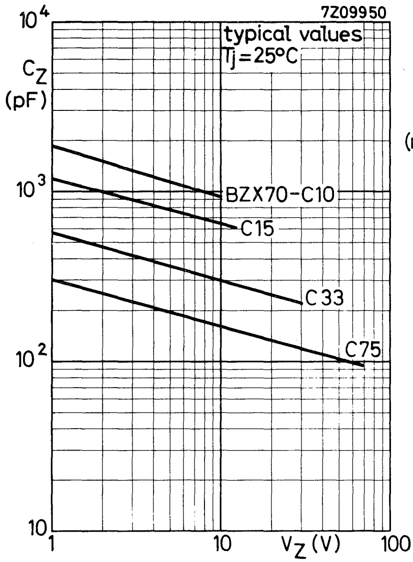
1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 60 °C/W
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 70 °C/W

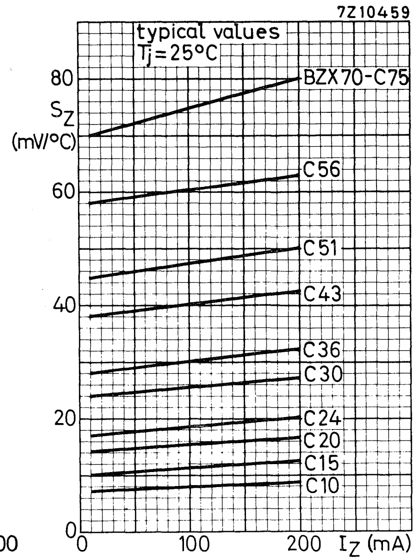


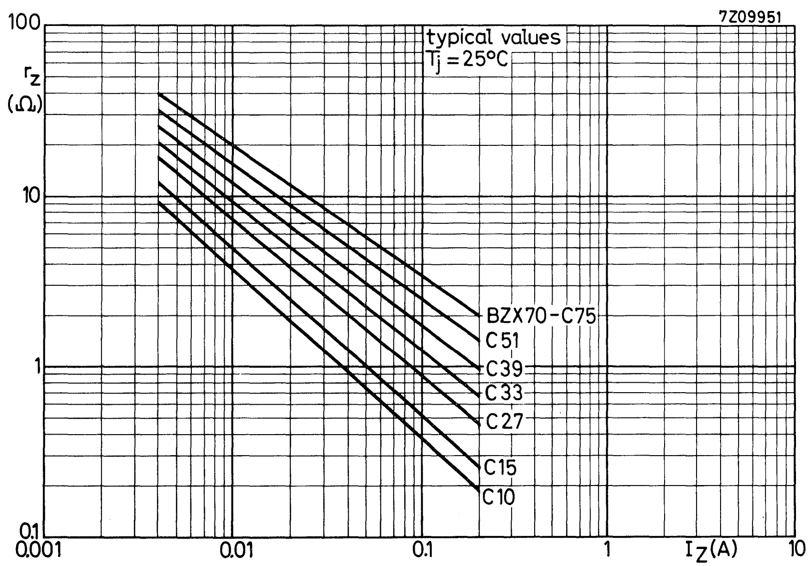
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j-a}$ = 85 °C/W
4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j-a}$ = 95 °C/W

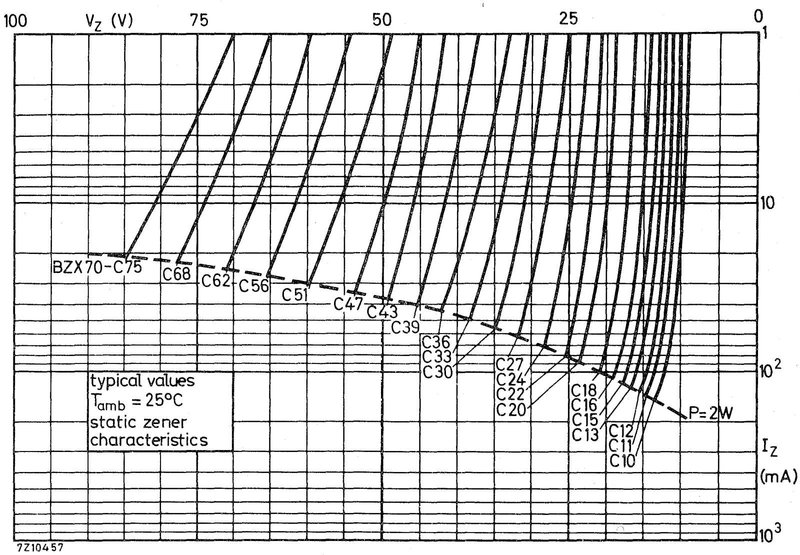


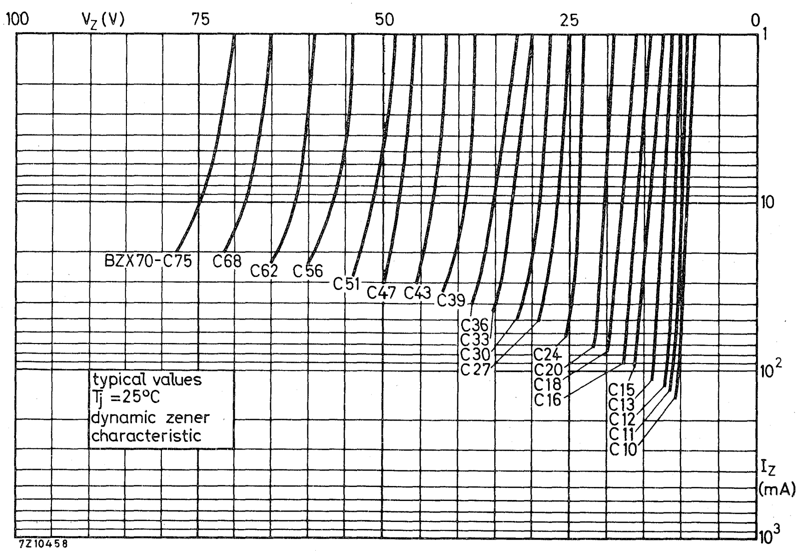
1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

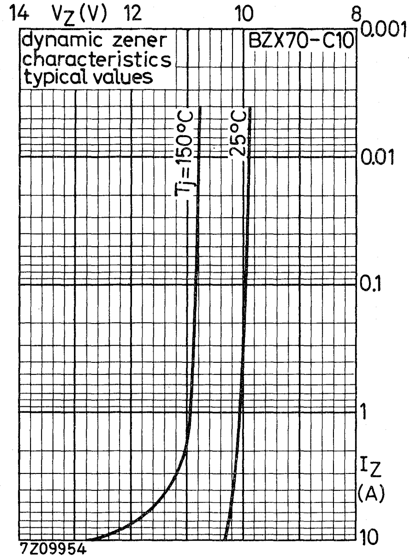

7Z09950
typical values
Tj = 25°C
C_Z (pF)
10^4
10^3
10^2
10
BZX70-C10
C15
C33
C75
1
10
V_Z (V)
100

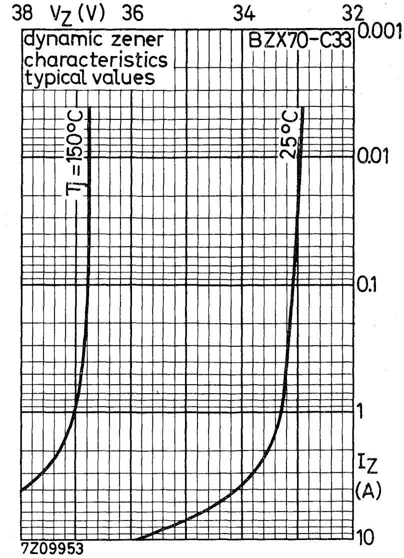

7Z10459
typical values
Tj = 25°C
S_Z (mV/°C)
80
60
40
20
0
BZX70-C75
C56
C51
C43
C36
C30
C24
C20
C15
C10
0
100
200
I_Z (mA)

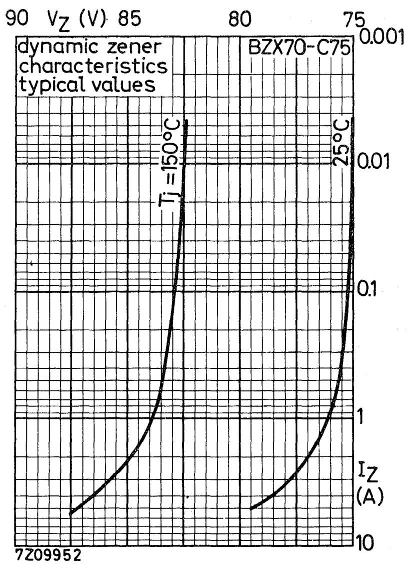

7Z09951
typical values
Tj = 25°C
r_Z (Ω)
100
10
1
0.1
BZX70-C75
C51
C39
C33
C27
C15
C10
0.001
0.01
0.1
1
I_Z(A)
10

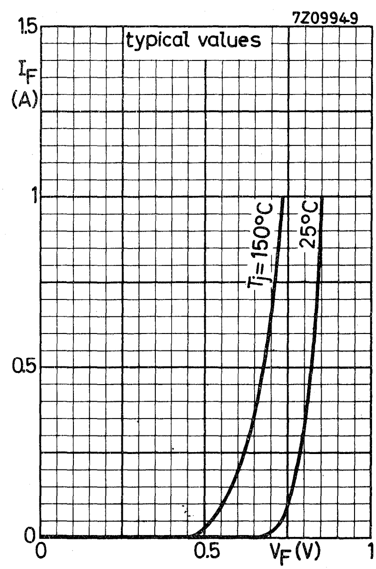

100
V_Z (V)
75
50
25
0
1
10
10^2
10^3
I_Z
(mA)
BZX70-C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
C11
C10
P=2W
typical values
T_{amb} = 25°C
static zener
characteristics
7Z10457

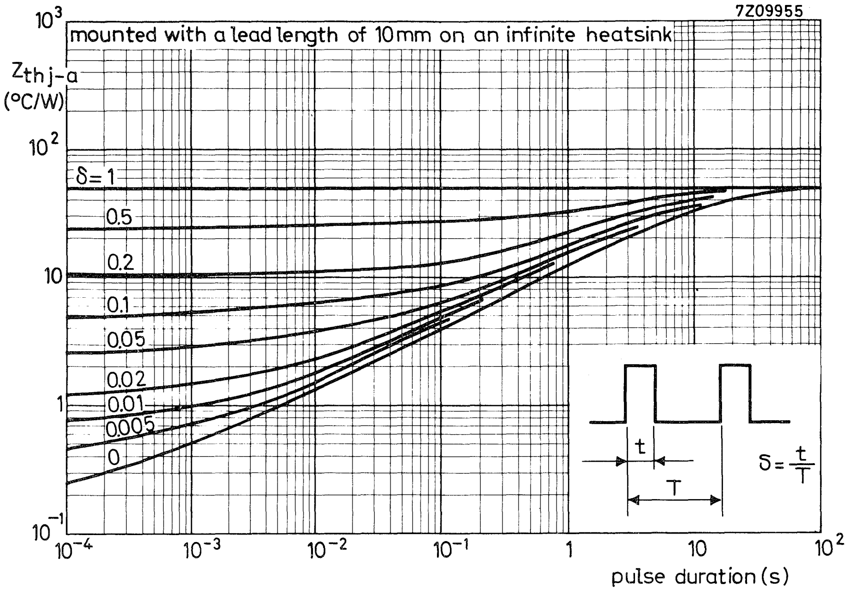

100
V_Z (V)
75
50
25
0
1
10
10^2
10^3
I_Z
(mA)
BZX70-C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
C30
C27
C24
C20
C18
C16
C15
C13
C12
C11
C10
typical values
T_j = 25°C
dynamic zener
characteristic
7Z10458

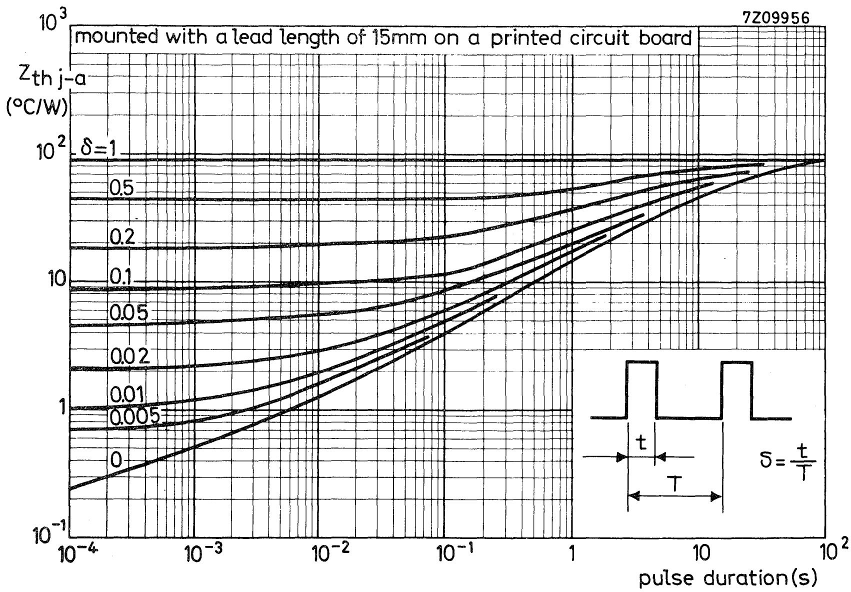

14 VZ(V) 12 10 8
dynamic zener characteristics typical values
BZX70-C10
0.001
0.01
0.1
1
IZ (A)
10
Tj=150°C
25°C
7Z09954

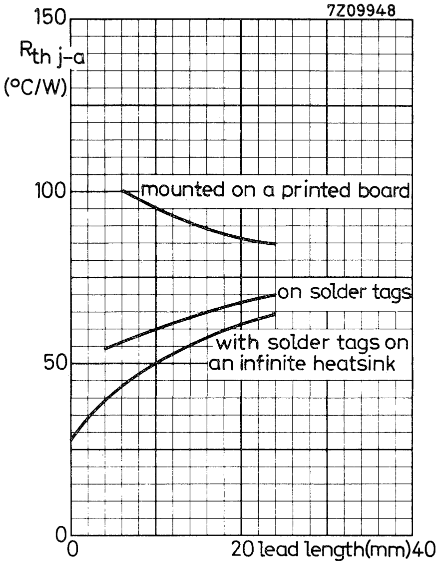

38 VZ(V) 36 34 32
dynamic zener characteristics typical values
BZX70-C33
0.001
0.01
0.1
1
IZ (A)
10
Tj=150°C
25°C
7Z09953

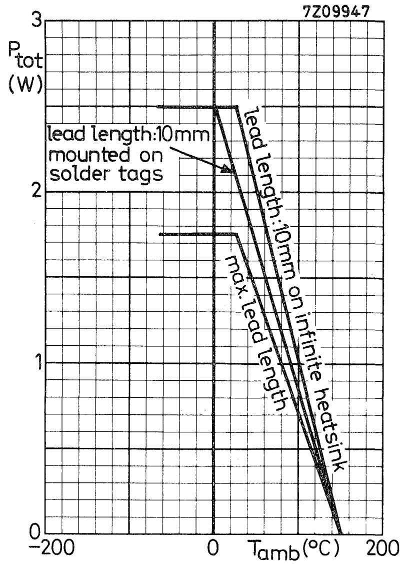

90 VZ (V) 85 80 75
dynamic zener characteristics typical values
BZX70-C75
0.001
0.01
0.1
1
IZ (A)
10
Tj=150°C
25°C
7Z09952

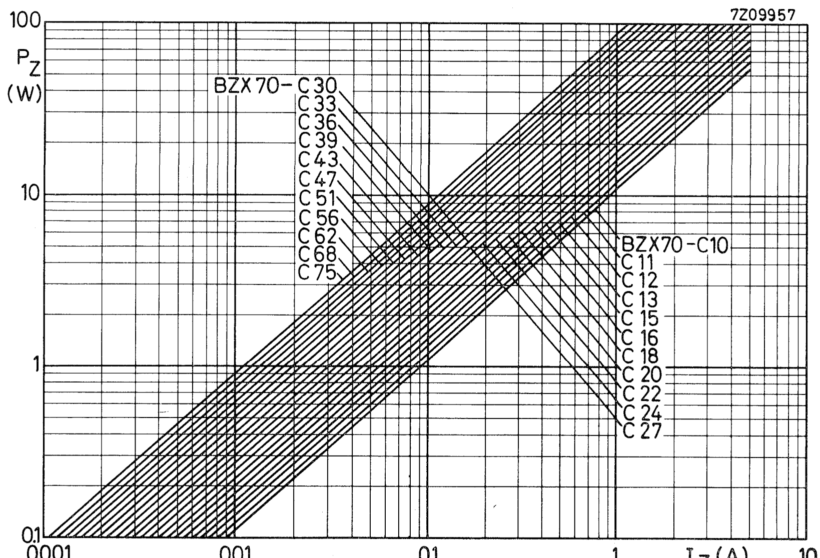

7Z09949
typical values
1.5
IF (A)
1
0.5
0
0
0.5
VF (V)
1
Tj=150°C
25°C


7Z09955
mounted with a lead length of 10mm on an infinite heatsink
$Z_{th\ j-a}$ (°C/W)
10^3
10^2
10
1
10^{-1}
δ = 1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
0
t
T
$\delta = \frac{t}{T}$
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
pulse duration (s)


7Z09956
mounted with a lead length of 15mm on a printed circuit board
$Z_{th\ j-a}$ (°C/W)
10^3
10^2
10
1
10^{-1}
δ = 1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
0
t
T
$\delta = \frac{t}{T}$
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
pulse duration (s)


7Z09948
150
$R_{th\ j-a}$
(°C/W)
100
50
0
mounted on a printed board
on solder tags
with solder tags on
an infinite heatsink
0
20 lead length(mm) 40


7Z09947
3
P_{tot}
(W)
2
1
0
lead length:10mm
mounted on
solder tags
lead length:10mm on infinite heatsink
max. lead length
−200
0
T_{amb} (°C)
200


7Z09957
100
P_Z
(W)
10
1
0.1
BZX70−C30
C33
C36
C39
C43
C47
C51
C56
C62
C68
C75
BZX70-C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
0.001
0.01
0.1
1
I_Z (A)
10

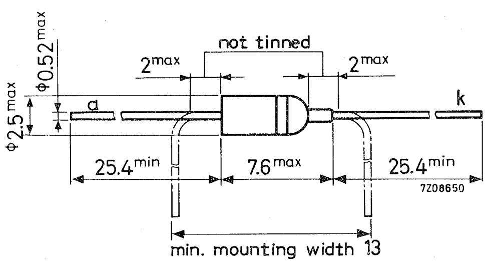
STABISTORS

Diodes with controlled conductance in a subminiature DO-7 envelope intended for low voltage regulation in circuits for clipping, coupling, clamping, meter protection, bias regulation and in many applications which require tight tolerances and low voltage levels.
The series consists of 4 types with nominal zener voltages ranging from 1.4 to 3.6 V with a tolerance of ± 5%.

QUICK REFERENCE DATA				
Regulation voltage (forward voltage)	V_F	nom.	1.4 to 3.6	V
Regulation voltage tolerance			± 5	%
Reverse voltage (d.c.)	V_R	max.	10	V
(repetitive peak)	V_{RRM}	max.	10	V
Repetitive peak forward current	I_{FRM}	max.	250	mA
Total power dissipation up to $T_{amb} = 35\,^oC$	P_{tot}	max.	400	mW
Junction temperature	T_j	max.	175	^oC

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

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

Voltages

Reverse voltage (d.c.)	V_R	max.	10	V
(repetitive peak)	V_{RRM}	max.	10	V

Current

Repetitive peak forward current	I_{FRM}	max.	250	mA

Power dissipation

Total power dissipation up to T_{amb} = 35 °C	P_{tot}	max.	400	mW

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.35	°C/mW

CHARACTERISTICS

BZX75-...	Regulation voltage V_F (forward voltage) at I_F = 1 mA min.		max.	Temperature coefficient S_F at I_F = 1 mA typ.	Differential resistance r_d f = 1 kHz at I_F = 1 mA typ.	
C1V4	1.16		1.34 V	4 mV/°C	60 Ω	
C2V1	1.75		2.05 V	6 mV/°C	90 Ω	
C2V8	2.33		2.70 V	8 mV/°C	120 Ω	
C3V6	3.02		3.45 V	10 mV/°C	150 Ω	
	at I_F = 10 mA			at I_F = 10 mA	at I_F = 10 mA	
	min.	nom.	max.	typ.	typ.	max.
C1V4	1.33	1.4	1.47 V	3.3 mV/°C	6	10 Ω
C2V1	1.99	2.1	2.21 V	5.0 mV/°C	9	15 Ω
C2V8	2.66	2.8	2.94 V	6.6 mV/°C	12	20 Ω
C3V6	3.12	3.6	3.78 V	8.2 mV/°C	15	25 Ω

Reverse current

V_R = 5 V

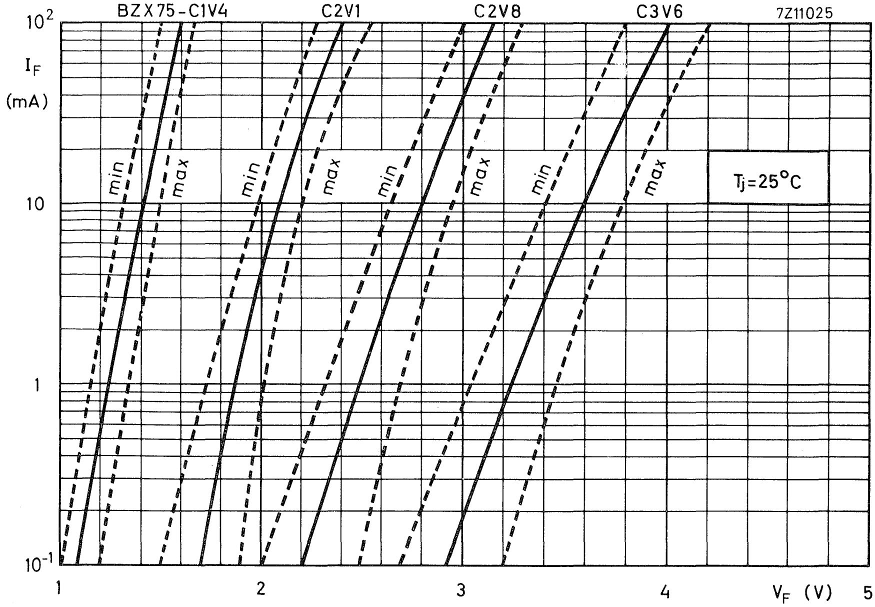
BZX75-C1V4 BZX75-C2V1	I_R	< 500	nA
BZX75-C2V8 BZX75-C3V6	I_R	< 200	nA

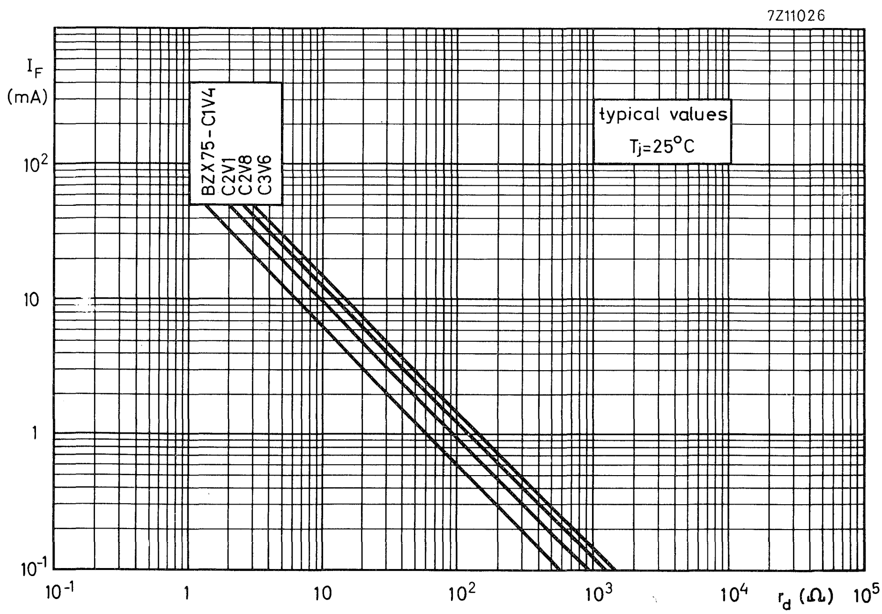
Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω — Q_s > 600 pC

Diode capacitance

V_R = 0; f = 1 MHz — C_d < 250 pF


7Z11025
BZX75-C1V4
C2V1
C2V8
C3V6
I_F
(mA)
10^2
10
1
10^{-1}
min
max
min
max
min
max
min
max
$T_j=25^{\circ}C$
1
2
3
4
V_F (V)
5


7Z11026
I_F
(mA)
10^2
10
1
10^{-1}
BZX75-C1V4
C2V1
C2V8
C3V6
typical values
$T_j=25^{\circ}C$
10^{-1}
1
10
10^2
10^3
10^4
r_d (Ω)
10^5

VOLTAGE REGULATOR DIODES

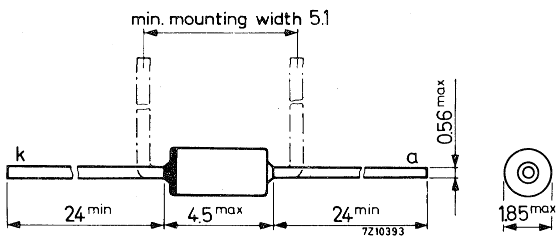
Silicon planar diodes in a DO-35 envelope intended for use as low power voltage stabilizers or voltage references.
The series consists of 30 types with nominal zener voltages ranging from 4.7 V to 75 V with a tolerance of $\pm5\%$.

QUICK REFERENCE DATA				
Zener voltage range		nom.	4.7 to 75	V
Zener voltage tolerance			±5	%
Total power dissipation up to $T_{amb} = 25\ ^{o}C$	P_{tot}	max.	400	mW
Non-repetitive peak reverse power	P_{ZSM}	max.	15	W
Junction temperature	T_j	max.	200	^{o}C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.44	$^{o}C/mW$

MECHANICAL DATA

Dimensions in mm

DO-35



Cathode indicated by coloured mark

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

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	250	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	400	mW
Non-repetitive peak reverse power t = 100 μs; T_j = 150 °C	P_{ZSM}	max.	15	W

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a}$	=	0.44	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 10 mA; T_{amb} = 25 °C	V_F	<	0.9	V

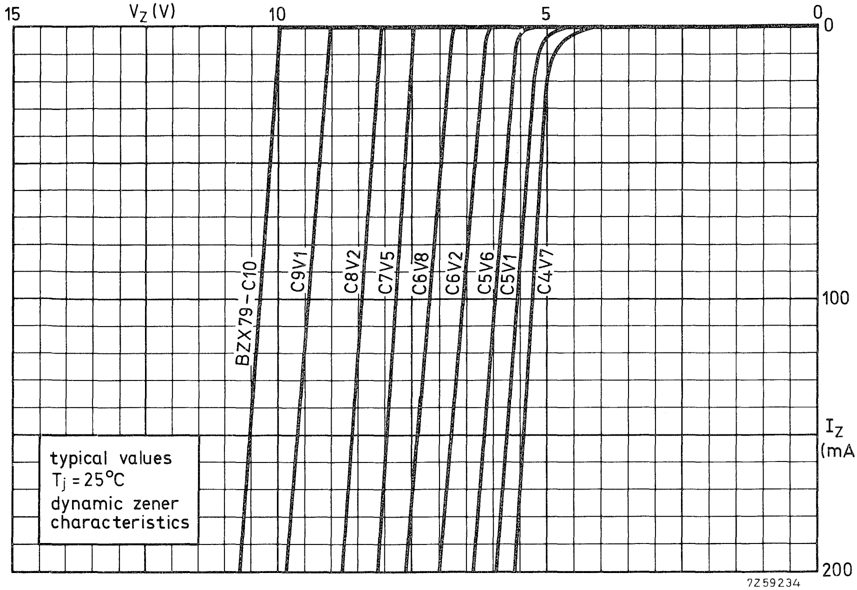
Reverse current

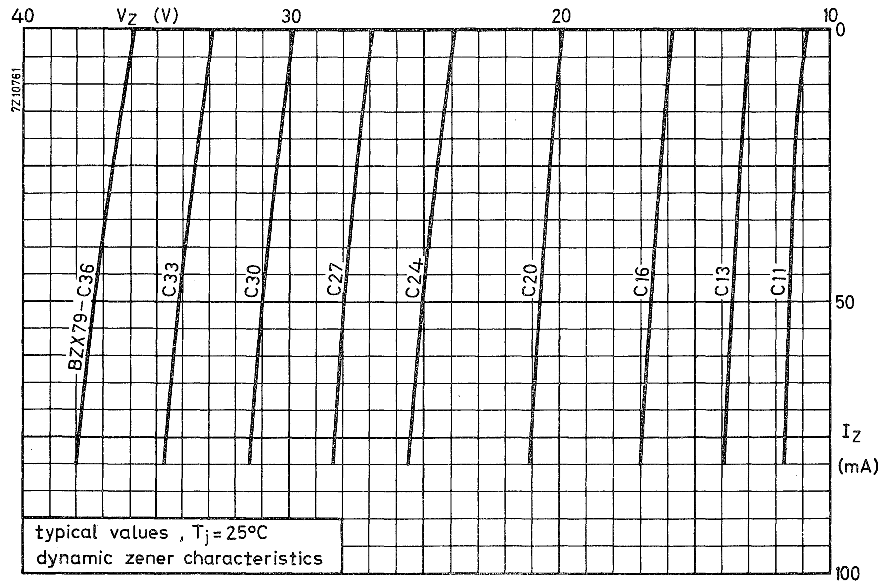
BZX79-C4V7	V_R = 2 V	I_R	<	3000	nA
C5V1	V_R = 2 V	I_R	<	2000	nA
C5V6	V_R = 2 V	I_R	<	1000	nA
C6V2	V_R = 2 V	I_R	<	500	nA
C6V8 to C8V2	V_R = 3 V	I_R	<	100	nA
C9V1	V_R = 5 V	I_R	<	100	nA
C10 to C12	$V_R = \frac{2}{3} \cdot V_{Znom}$	I_R	<	100	nA
C13 to C75	$V_R = \frac{2}{3} \cdot V_{Znom}$	I_R	<	50	nA

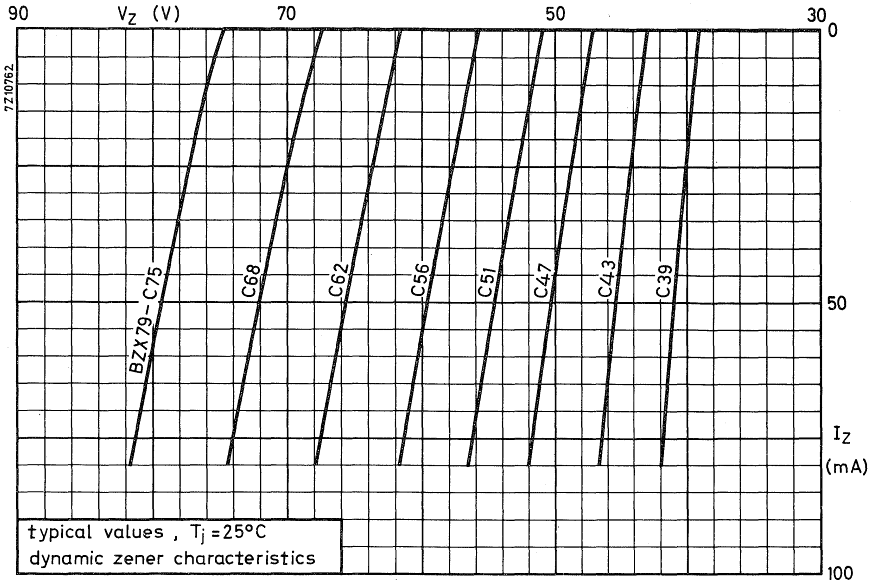
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

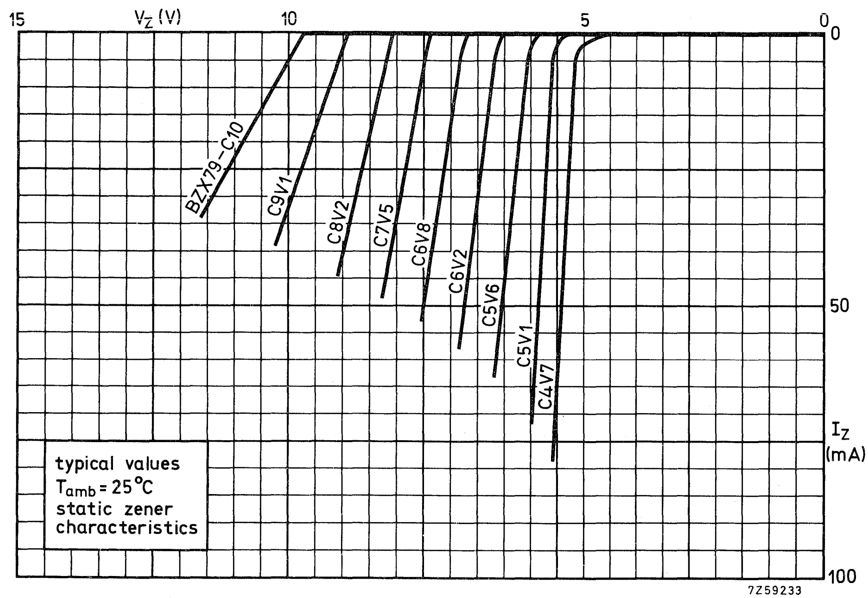
BZX79-...	Zener voltage V_Z at I_Z = 5 mA min.	nom.	max.	Temperature coefficient S_Z at I_Z = 5 mA typ.	Differential resistance r_Z at I_Z = 5 mA f = 1 kHz max.	Diode capacitance C_d at f = 1 MHz; V_R = 0 typ.
C4V7	4.4	4.7	5.0 V	− 1.4 mV/°C	80 Ω	130 pF
C5V1	4.8	5.1	5.4 V	− 0.8 mV/°C	60 Ω	110 pF
C5V6	5.3	5.6	6.0 V	+ 1.2 mV/°C	25 Ω	95 pF
C6V2	5.8	6.2	6.6 V	+ 2.3 mV/°C	10 Ω	90 pF
C6V8	6.4	6.8	7.2 V	+ 3.0 mV/°C	15 Ω	85 pF
C7V5	7.1	7.5	7.9 V	+ 4.0 mV/°C	15 Ω	80 pF
C8V2	7.8	8.2	8.7 V	+ 5.0 mV/°C	15 Ω	75 pF
C9V1	8.6	9.1	9.6 V	+ 6.0 mV/°C	15 Ω	70 pF
C10	9.4	10	10.6 V	+ 7.0 mV/°C	20 Ω	70 pF
C11	10.4	11	11.6 V	+ 8.0 mV/°C	20 Ω	65 pF
C12	11.4	12	12.6 V	+ 9.0 mV/°C	25 Ω	65 pF
C13	12.4	13	14.1 V	+10.5 mV/°C	30 Ω	60 pF
C15	13.9	15	15.6 V	+12.5 mV/°C	30 Ω	55 pF
C16	15.4	16	17.1 V	+13.0 mV/°C	40 Ω	52 pF
C18	16.9	18	19.1 V	+15.0 mV/°C	45 Ω	47 pF
C20	18.9	20	21.2 V	+17.0 mV/°C	55 Ω	36 pF
C22	20.8	22	23.3 V	+19.0 mV/°C	55 Ω	34 pF
C24	22.7	24	25.9 V	+21.0 mV/°C	70 Ω	33 pF
C27	25.1	27	28.9 V	+23.5 mV/°C	80 Ω	30 pF
C30	28	30	32 V	+ 26 mV/°C	80 Ω	27 pF
C33	31	33	35 V	+ 29 mV/°C	80 Ω	25 pF
C36	34	36	38 V	+ 31 mV/°C	90 Ω	23 pF

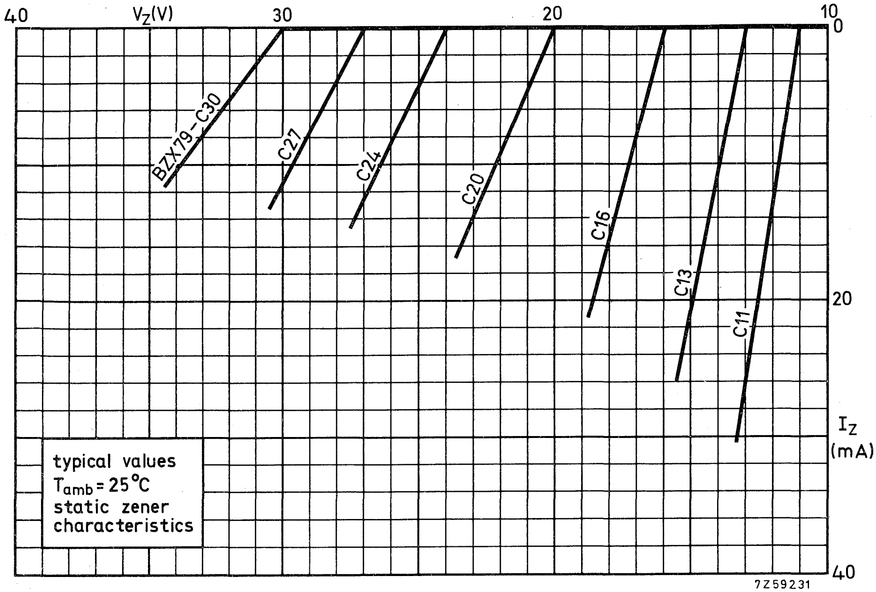
	at I_Z = 2 mA min.	nom.	max.	at I_Z = 2 mA typ.	at I_Z = 2 mA max.	typ.
C39	37	39	41 V	+ 34 mV/°C	130 Ω	21 pF
C43	40	43	45 V	+ 37 mV/°C	150 Ω	21 pF
C47	44	47	50 V	+ 40 mV/°C	170 Ω	19 pF
C51	48	51	54 V	+ 44 mV/°C	180 Ω	19 pF
C56	53	56	60 V	+ 47 mV/°C	200 Ω	18 pF
C62	58	62	66 V	+ 51 mV/°C	215 Ω	17 pF
C68	64	68	72 V	+ 56 mV/°C	240 Ω	17 pF
C75	71	75	79 V	+ 60 mV/°C	255 Ω	16.5 pF

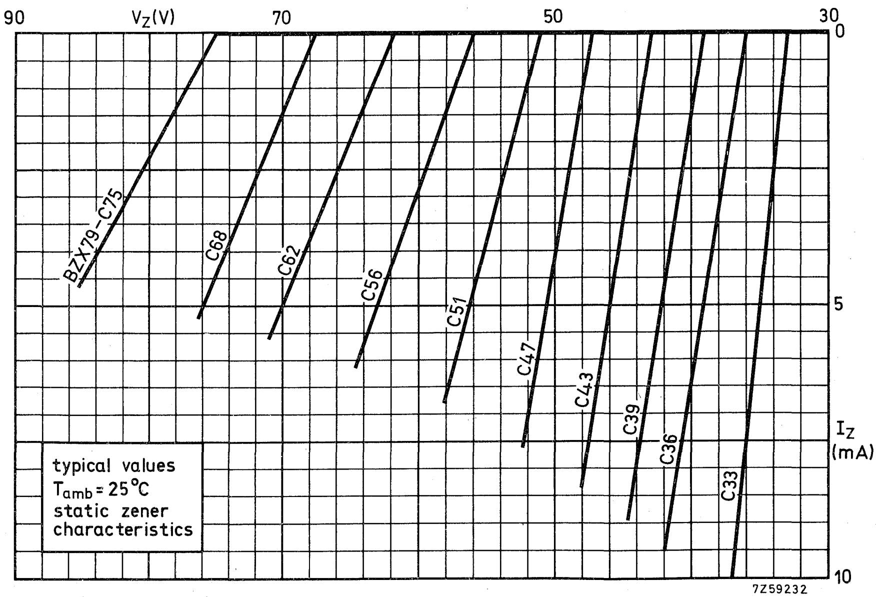

15
V_Z (V)
10
5
0
0
100
200
I_Z
(mA)
BZX79 – C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
typical values
$T_j = 25°C$
dynamic zener
characteristics
7Z59234

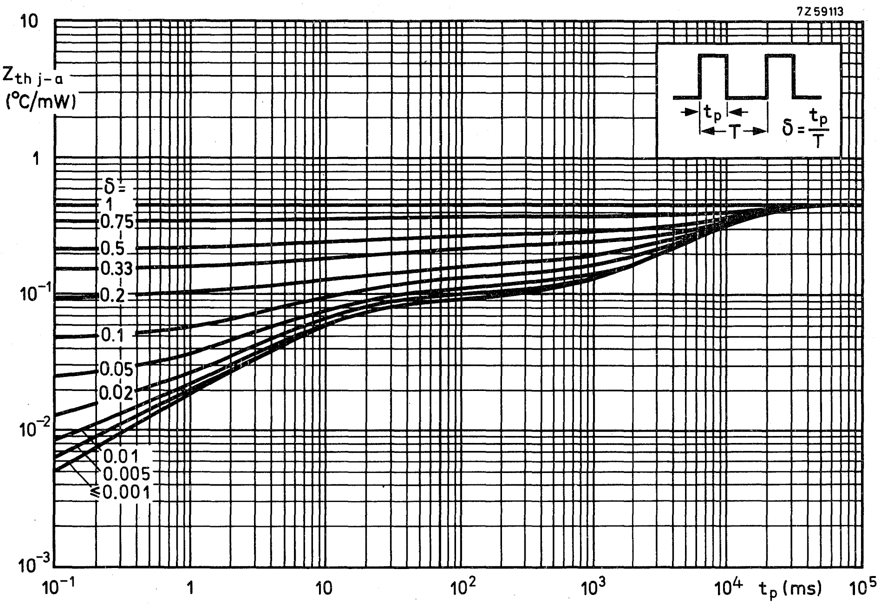

40
V_Z (V)
30
20
10
0
50
100
I_Z
(mA)
7Z10761
BZX79–C36
C33
C30
C27
C24
C20
C16
C13
C11
typical values , $T_j = 25°C$
dynamic zener characteristics

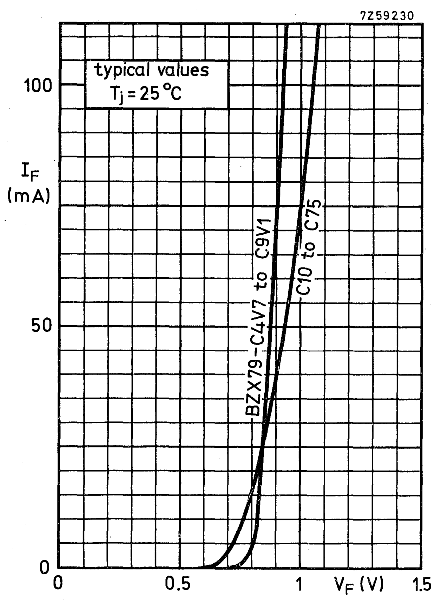

90
V_Z (V)
70
50
30
0
7Z10762
BZX79–C75
C68
C62
C56
C51
C47
C43
C39
50
I_Z
(mA)
100
typical values , T_j = 25°C
dynamic zener characteristics

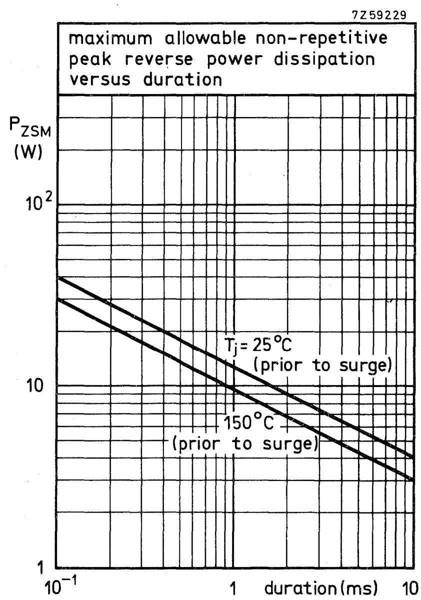

15
V_Z (V)
10
5
0
0
BZX79–C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
50
I_Z
(mA)
100
typical values
T_{amb} = 25°C
static zener
characteristics
7Z59233

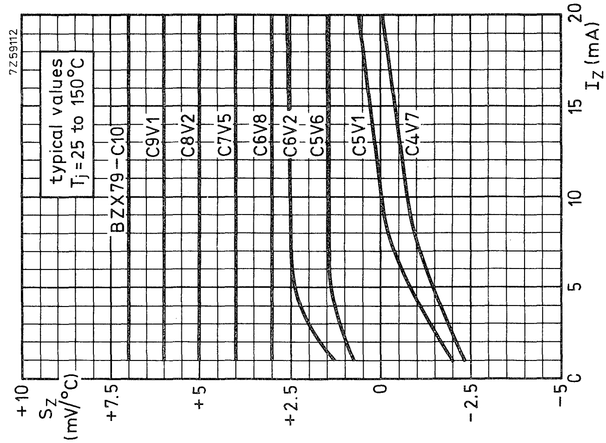

40
V_Z(V)
30
20
10
0
20
40
I_Z (mA)
BZX79–C30
C27
C24
C20
C16
C13
C11
typical values
T_{amb} = 25 °C
static zener
characteristics
7Z59231

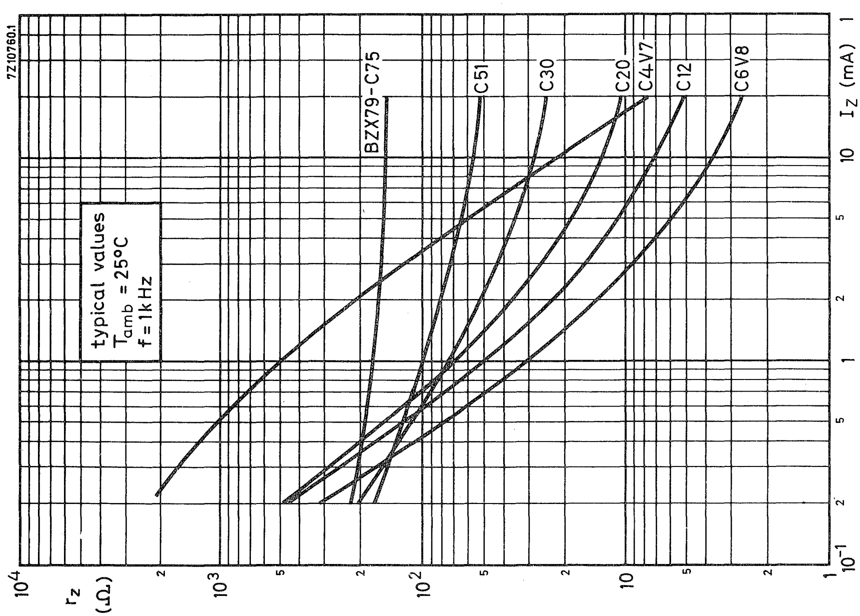

90
V_Z(V)
70
50
30
0
5
10
I_Z (mA)
BZX79–C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
typical values
T_{amb} = 25 °C
static zener
characteristics
7Z59232


7Z59113
10
1
10^{-1}
10^{-2}
10^{-3}
$Z_{th\ j-a}$
(°C/mW)
δ =
1
0.75
0.5
0.33
0.2
0.1
0.05
0.02
0.01
0.005
≤0.001
t_p
T
$\delta = \frac{t_p}{T}$
10^{-1}
1
10
10^2
10^3
10^4
t_p (ms)
10^5


7Z59230
typical values
$T_j = 25\ ^\circ C$
100
50
0
I_F
(mA)
BZX79-C4V7 to C9V1
C10 to C75
0
0.5
1
V_F (V)
1.5


7Z59229
maximum allowable non-repetitive
peak reverse power dissipation
versus duration
P_{ZSM}
(W)
10^2
10
1
$T_j = 25\ ^\circ C$
(prior to surge)
150 °C
(prior to surge)
10^{-1}
1
duration (ms)
10


7Z59112
typical values
T_j = 25 to 150°C
BZX79-C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
S_Z (mV/°C)
+10
+7.5
+5
+2.5
0
−2.5
−5
0
5
10
15
20
I_Z (mA)


7Z10760.1
typical values
T_{amb} = 25°C
f = 1 kHz
BZX79-C75
C51
C30
C20
C4V7
C12
C6V8
r_Z (Ω)
10^4
10^3
10^2
10
1
10^{-1}
1
10
I_Z (mA)

LOW POWER VOLTAGE REGULATORS

Alloyed silicon diodes in a DO-7 envelope intended for use as low power voltage stabilisers or voltage references.
Zener voltage range from 4.7 to 9.1 V with a tolerance of ± 5%.

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

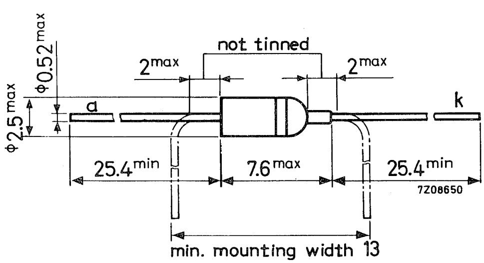
Forward current (d.c.)	I_F	max.	50	mA
Zener current (d.c.)	I_Z	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	280	mW
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

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

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode side

FOR NEW DESIGN THE SUCCESSOR TYPES BZX79-C5V1 to BZX79-C9V1 ARE RECOMMENDED

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

Forward voltage at I_F = 0.1 mA	V_F	typ.	0.61	V
I_F = 10 mA	V_F	typ.	0.76	V
Reverse current at V_R = 1.0 V; T_{amb} = 60 °C	I_R	typ.	4	nA

	Zener voltage at I_Z = 1 mA min.	nom.	max.	Temperature coefficient at I_Z = 1 mA typ.	Differential resistance at I_Z = 1 mA typ.
BZY56	4.4	4.7	5.0 V	−2.0 mV/°C	370 Ω
BZY57	4.8	5.1	5.4 V	−1.8 mV/°C	360 Ω
BZY58	5.3	5.6	6.0 V	−1.0 mV/°C	280 Ω
BZY59	5.8	6.2	6.6 V	+0.5 mV/°C	200 Ω
BZY60	6.4	6.8	7.2 V	+2.7 mV/°C	5.0 Ω
BZY61	7.1	7.5	7.9 V	+4.0 mV/°C	8.0 Ω
BZY62	7.7	8.2	8.7 V	+5.0 mV/°C	6.2 Ω
BZY63	8.6	9.1	9.6 V	+6.2 mV/°C	8.0 Ω

	Zener voltage at I_Z = 5 mA typ.	Temperature coefficient at I_Z = 5 mA typ.	Differential resistance at I_Z = 5 mA typ.
BZY56	5.2 V	−1.2 mV/°C	62 Ω
BZY57	5.6 V	−0.5 mV/°C	50 Ω
BZY58	6.0 V	+1.0 mV/°C	28 Ω
BZY59	6.3 V	+1.8 mV/°C	12 Ω
BZY60	6.9 V	+3.1 mV/°C	3.5 Ω
BZY61	7.6 V	+4.3 mV/°C	2.8 Ω
BZY62	8.25 V	+5.2 mV/°C	3.2 Ω
BZY63	9.2 V	+6.4 mV/°C	4.4 Ω

	Zener voltage at I_Z = 20 mA typ.	Temperature coefficient at I_Z = 20 mA typ.	Differential resistance at I_Z = 20 mA typ.
BZY56	5.6 V	0.0 mV/°C	9.5 Ω
BZY57	5.9 V	+1.0 mV/°C	6.0 Ω
BZY58	6.2 V	+2.0 mV/°C	3.2 Ω
BZY59	6.4 V	+2.5 mV/°C	2.0 Ω
BZY60	7.0 V	+3.6 mV/°C	1.5 Ω
BZY61	7.7 V	+4.6 mV/°C	1.7 Ω
BZY62	8.4 V	+5.5 mV/°C	2.0 Ω
BZY63	9.4 V	+6.6 mV/°C	2.7 Ω

VOLTAGE REFERENCE DIODE

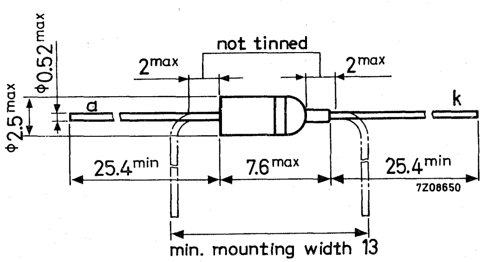
Silicon diode in a DO-7 envelope intended for use as a voltage reference diode in general industrial applications.
The BZY78 has an extremely high voltage stability (±1% at a zener current of 11.5 mA).

QUICK REFERENCE DATA				
Zener voltage at I_Z = 11.5 mA	V_Z	nom.	5.3	V
		5.1 to 5.6		V
Voltage stability at T_{amb} from −50 to 100 °C I_Z = 11.5 mA ±10%	$\frac{\Delta V_Z}{V_Z}$	−1 to +1		%
Repetitive peak zener current	I_{ZRM}	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	280	mW
Junction temperature	T_j	max.	150	°C
Thermal resistance	$R_{th\,j\text{-}a}$	=	0.45	°C/mW

MECHANICAL DATA

Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS (Limiting values) [1])

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	50	mA
Zener current (d.c. or average over any 20 ms period)	I_Z	max.	25	mA
Repetitive peak zener current	I_{ZRM}	max.	25	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	280	mW

Temperatures

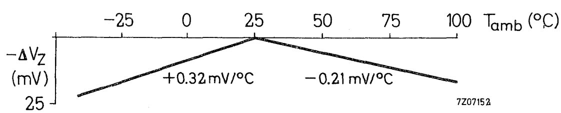
Storage temperature	T_{stg}	-55 to	+150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

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

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Zener voltage at I_Z = 11.5 mA	V_Z	nom.	5.3	V
		5.1 to	5.6	V
Forward voltage at I_F = 1 mA	V_F	0.65 to	0.75	V
Reverse current at V_R = 2 V	I_R	<	1.0	μA
Temperature coefficient I_Z = 11.5 mA ±10%; T_j = -40 to +25 °C	S_Z	typ.	+0.32	mV/°C
T_j = +25 to +100 °C	S_Z	typ.	-0.21	mV/°C



Differential resistance at I_Z = 11.5 mA	r_z	typ.	18	Ω
		15 to	20	Ω
Voltage stability at T_{amb} = -50 to +100 °C, I_Z = 11.5 mA ±10%	$\frac{\Delta V_Z}{V_Z}$	-1 to	+1	%

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

MOUNTING INSTRUCTIONS

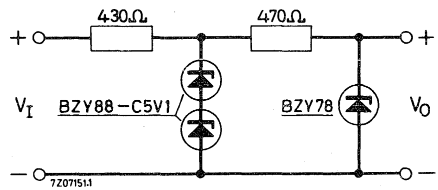
1. When using a soldering iron, the diode may be soldered directly into a circuit, but heat conducted to the junction should be kept to a minimum by use of a thermal shunt.

2. Diodes may be dip soldered at a solder temperature of 245 °C for a maximum soldering time of 5 seconds. The case temperature during dip soldering may exceed the maximum storage temperature for a period not greater than 2 minutes, provided that it at no time exceeds 115 °C. These recommendations apply to a diode with the anode end mounted flush on the board with punched-through holes or spaced at least 1.5 mm above a board with plated-through holes. For mounting the cathode end onto the board the diode must be spaced at least 5 mm 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.

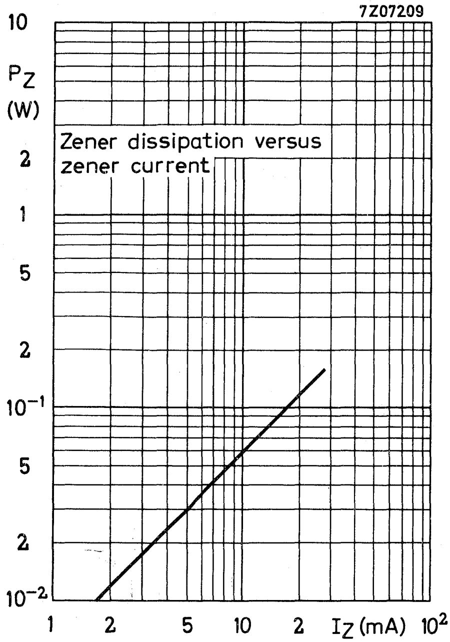
3. Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

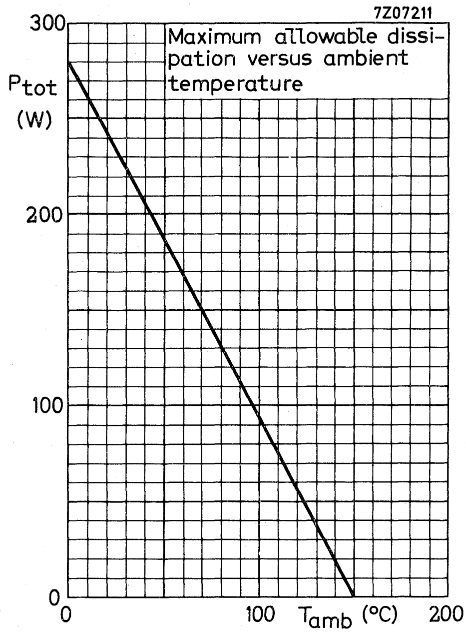
APPLICATION INFORMATION

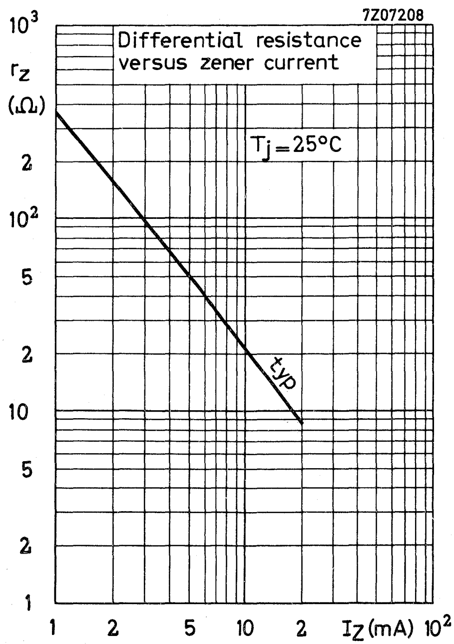
Typical reference-voltage circuit

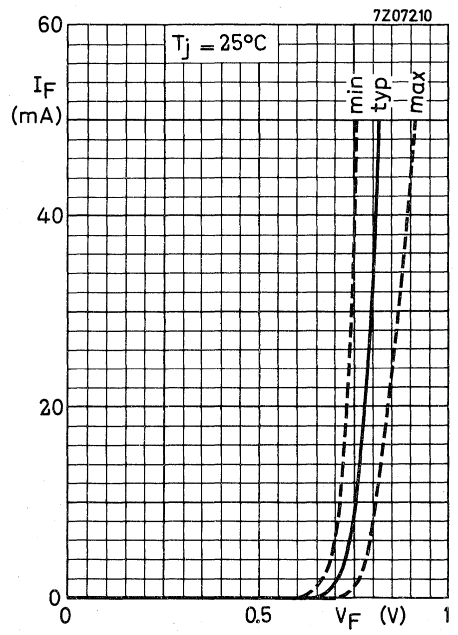


Temperature range	T_{amb}	0 to +50 °C	
Input voltage	V_I	24 V	± 10%
Output voltage	V_O	5.1 to 5.6 V	±0.3%


7Z07209
Zener dissipation versus zener current
P_Z (W)
10
2
1
5
2
10^{-1}
5
2
10^{-2}
1
2
5
10
2
I_Z (mA)
10^2


7Z07211
Maximum allowable dissipation versus ambient temperature
P_{tot} (W)
300
200
100
0
0
100
T_{amb} (°C)
200


7Z07208
Differential resistance versus zener current
r_Z (Ω)
$T_j = 25°C$
typ
10^3
2
10^2
5
2
10
5
2
1
1
2
5
10
2
I_Z (mA)
10^2


7Z07210
$T_j = 25°C$
I_F (mA)
min
typ
max
60
40
20
0
0
0.5
V_F (V)
1

VOLTAGE REGULATOR DIODES

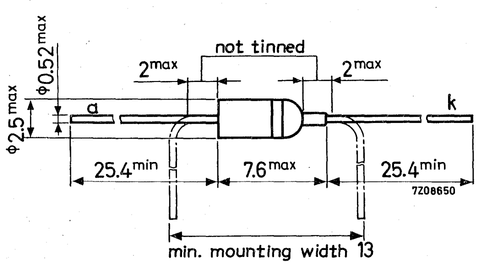
Silicon diodes in subminiature all glass DO-7 envelope for use as low current voltage stabilizers or voltage references.
The series consists of 24 types with nominal zener voltages ranging from 3.3 V to 30 V with a tolerance of ±5%.

QUICK REFERENCE DATA				
Zener voltage range		nom.	3.3 to 30	V
Zener voltage tolerance			±5	%
Repetitive peak zener current	I_{ZRM}	max.	250	mA
Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	400	mW
Non repetitive peak reverse power T_j = 150 °C; t = 100 μs	P_{ZSM}	max.	15	W
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.31	°C/mW

MECHANICAL DATA

Dimensions in mm

DO-7



The band indicates the cathode

RATINGS (Limiting values) [1])

Currents

Forward current (d.c.)	I_F	max.	250	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA
Repetitive peak zener current	I_{ZRM}	max.	250	mA

Power dissipation

Total power dissipation up to $T_{amb} = 50\ ^oC$	P_{tot}	max.	400	mW
Non repetitive peak reverse power $T_j = 150\ ^oC$; $t = 100\ \mu s$	P_{ZSM}	max.	15	W

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.31	^oC/mW

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

Forward voltage

$I_F = 10$ mA	V_F	<	0.9	V

BZY88-...	Zener voltage V_Z at $I_Z = 1$ mA [2])				Temperature coefficient S_Z at $I_Z = 1$ mA				Differential resistance r_Z at $I_Z = 1$ mA			
	min.	nom.	max.		min.	typ.	max.		min.	typ.	max.	
C3V3	2.4	2.75	3.0	V	−4.5	−1.9	−0.5	mV/^oC	380	410	440	Ω
C3V6	2.7	3.0	3.3	V	−4.5	−2.05	−0.5	mV/^oC	380	410	430	Ω
C3V9	3.0	3.3	3.6	V	−3.5	−2.4	−0.5	mV/^oC	380	410	430	Ω
C4V3	3.3	3.6	3.9	V	−2.7	−2.25	−0.5	mV/^oC	340	410	430	Ω
C4V7	3.7	4.1	4.3	V	−2.5	−2.0	−0.3	mV/^oC	360	390	420	Ω
C5V1	4.3	4.65	5.0	V	−2.1	−1.9	−0.3	mV/^oC	300	340	370	Ω
C5V6	4.8	5.3	5.7	V	−1.8	−1.4	0	mV/^oC	160	310	350	Ω
C6V2	5.7	5.9	6.5	V	0	+1.6	+3.0	mV/^oC	10	100	250	Ω
C6V8	6.5	6.7	6.9	V	+ 2	+3.2	+3.7	mV/^oC	5	15	70	Ω
C7V5	7.0	7.45	7.8	V	+ 3	+4.2	+5.9	mV/^oC	4.0	8.6	20	Ω
C8V2	7.8	8.1	8.5	V	+4.3	+5.0	+6.0	mV/^oC	4.0	10	20	Ω
C9V1	8.55	9.0	9.5	V	+4.5	+6.0	+7.0	mV/^oC	7	12	24	Ω

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

[2]) C3V3 to C9V1 at $T_{amb} = 25\ ^oC$.

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

BZY88-...	Zener voltage V_Z at I_Z = 5 mA 2)				Temperature coefficient S_Z at I_Z = 5 mA				Differential resistance r_Z at I_Z = 5 mA			
	min.	nom.	max.		min.	typ.	max.		min.	typ.	max.	
C3V3	3.1	3.3	3.5	V	-4.0	-2.3	-0.5	mV/°C	70	83.5	110	Ω
C3V6	3.4	3.6	3.8	V	-3.5	-2.0	-0.5	mV/°C	65	76	105	Ω
C3V9	3.7	3.9	4.1	V	-2.5	-2.05	-0.5	mV/°C	60	76	100	Ω
C4V3	4.0	4.3	4.5	V	-2.5	-1.8	-0.5	mV/°C	55	70	90	Ω
C4V7	4.4	4.7	5.0	V	-2.0	-1.55	0	mV/°C	49	62	85	Ω
C5V1	4.8	5.1	5.4	V	-1.75	-1.2	0	mV/°C	34	46	75	Ω
C5V6	5.3	5.6	6.0	V	-1.5	-0.2	+1.0	mV/°C	10	22	55	Ω
C6V2	5.8	6.2	6.6	V	+0.5	+2.0	+3.5	mV/°C	1	7	27	Ω
C6V8	6.4	6.8	7.2	V	+2.3	+3.2	+3.8	mV/°C	0.5	3.0	15	Ω
C7V5	7.1	7.5	7.9	V	+3.1	+4.2	+5.9	mV/°C	0.5	3.0	15	Ω
C8V2	7.8	8.2	8.7	V	+4.2	+5.0	+6.0	mV/°C	0.9	3.5	20	Ω
C9V1	8.6	9.1	9.6	V	+4.8	+6.0	+7.0	mV/°C	1.0	4.75	25	Ω
C10	9.4	10	10.6	V	-	+7.0	-	mV/°C	-	-	25	Ω
C11	10.4	11	11.6	V	-	+8.7	-	mV/°C	-	-	35	Ω
C12	11.4	12	12.6	V	-	+9.0	-	mV/°C	-	-	35	Ω
C13	12.4	13	14.1	V	-	+10.5	-	mV/°C	-	-	35	Ω
C15	13.9	15	15.6	V	-	+12.5	-	mV/°C	-	-	40	Ω
C16	15.4	16	17.1	V	-	+13	-	mV/°C	-	-	45	Ω
C18	16.9	18	19.1	V	-	+15	-	mV/°C	-	-	50	Ω
C20	18.9	20	21.2	V	-	+17	-	mV/°C	-	-	60	Ω
C22	20.8	22	23.3	V	-	+19	-	mV/°C	-	-	65	Ω
C24	22.7	24	25.9	V	-	+21	-	mV/°C	-	-	75	Ω
C27	25.1	27	28.9	V	-	+23.5	-	mV/°C	-	-	85	Ω
C30	28	30	32	V	-	+26	-	mV/°C	-	-	95	Ω

	at I_Z = 20 mA 2)				at I_Z = 20 mA				at I_Z = 20 mA			
	min.	nom.	typ.		min.	typ.	max.		min.	typ.	max.	
C3V3	3.5	4	4.2	V	-3.3	-2.4	-0.5	mV/°C	16.0	19.5	22	Ω
C3V6	3.9	4.2	4.4	V	-2.5	-1.55	-0.5	mV/°C	16	18	20	Ω
C3V9	4.2	4.45	4.65	V	-2.4	-1.55	-0.5	mV/°C	14	16	18	Ω
C4V3	4.45	4.7	4.95	V	-2.0	-1.5	-0.5	mV/°C	13	15	17	Ω
C4V7	4.9	5.1	5.3	V	-1.5	-0.85	0	mV/°C	12	15	17	Ω
C5V1	5.1	5.35	5.7	V	-1.5	-0.8	0	mV/°C	4	7	11	Ω
C5V6	5.45	5.75	6.1	V	-1.0	+1.0	+3.0	mV/°C	1.5	4.0	8.0	Ω
C6V2	5.95	6.4	6.7	V	+1.0	+2.2	+4.0	mV/°C	0.8	1.4	3.1	Ω
C6V8	6.6	6.9	7.25	V	+2.8	+3.2	+3.8	mV/°C	0.7	1.3	3.0	Ω
C7V5	7.2	7.65	7.95	V	+2.5	+4.2	+5.9	mV/°C	0.5	1.6	5.0	Ω
C8V2	7.9	8.4	8.75	V	+4	+5	+6	mV/°C	0.9	1.8	6.0	Ω
C9V1	8.7	9.4	9.7	V	+5	+6	+7	mV/°C	1.0	1.85	7.0	Ω

2) C3V3 to C9V1 at T_{amb} = 25 °C

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

BZY88-...	Diode capacitance C_d at V_R = 3 V (typ.)	Reverse current I_R at V_R =	typ.	max.	
C3V3	395 pF	1 V	0.54	3.0	μA
C3V6	370 pF	1 V	0.25	3.0	μA
C3V9	335 pF	1 V	0.11	3.0	μA
C4V3	270 pF	1 V	0.1	3.0	μA
C4V7	290 pF	2 V	0.25	3.0	μA
C5V1	275 pF	2 V	0.15	1.0	μA
C5V6	260 pF	2 V	0.6	1.0	μA
C6V2	240 pF	2 V	0.1	1.0	μA
C6V8	220 pF	3 V	0.025	1.0	μA
C7V5	190 pF	3 V	15	500	nA
C8V2	150 pF	3 V	11	400	nA
C9V1	140 pF	5 V	8	400	nA
C10 to C30	-	$\frac{2}{3} \cdot V_{Znom}$	-	2.5	μA

OPERATING NOTES

1. Dissipation and heatsink considerations

a. Steady-state conditions

The maximum allowable steady-state dissipation $P_{s\,max}$ 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 additional pulse power $P_{m\,max}$ is given by the formula

$$P_{m\,max} = \frac{(T_{j\,max} - T_{amb}) - (P_s \cdot R_{th\,j\text{-}a})}{R_{th\,t}}$$

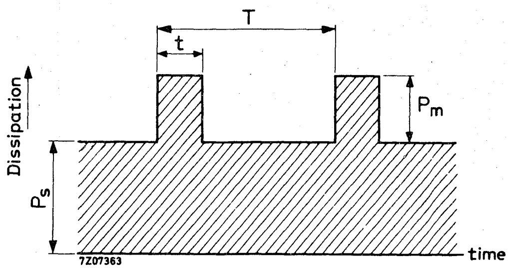
where P_s is the steady-state dissipation, excluding that in the pulses,

$R_{th\,t}$ is the effective transient thermal resistance of the device from junction to ambient. It is a function of the pulse duration t and duty cycle δ (see page 9, lower figure).

δ is the duty cycle and is equal to the pulse duration t divided by the period duration T.

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 13, upper figure. With the additional pulsed power dissipation $P_{m\ max}$ calculated from the above expression, the total repetitive peak zener power dissipation $P_{ZRM} = P_s + P_{m\ max}$. From page 13, upper figure the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilization time of the diode t_{stab}, the maximum allowable repetitive peak dissipation P_{ZRM} is equal to the maximum steady-state power $P_{s\ max}$. The temperature stabilization time for the BZY88series is 100 s (see page 9, lower figure).



Example

The following example illustrates how to calculate the maximum permissible repetitive 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 13, upper figure) = 76 mW.
The thermal resistance from junction to ambient $R_{th\ j\text{-}a} = 0.31$ °C/mW.
The transient thermal resistance $R_{th\ t}$ with a duty cycle $\delta = 0.1$ and a pulse duration t = 1 ms (from page 9, lower figure).

$$R_{th\ t} = 41.5\ ^\circ\mathrm{C/W}$$

The maximum additional pulse power dissipation

$$P_{m\ max} = \frac{(T_{j\ max} - T_{amb}) - P_s \cdot R_{th\ j\text{-}a}}{R_{th\ t}}$$

If $P_s = 76$ mW, $R_{th\ t} = 41.5$ °C/W,

$$P_{m\ max} = \frac{(175\text{-}60)\text{-}(0.076 \times 310)}{41.5} = 2.2\ \mathrm{W}$$

therefore, the total repetitive peak power dissipation,

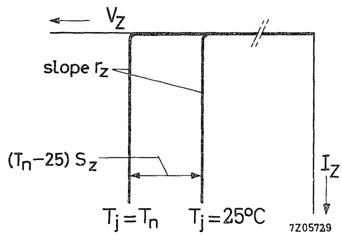
$$P_{ZRM} = 0.076 + 2.2 = 2.28\ \mathrm{W}$$

From page 13, upper figure, the corresponding repetitive peak zener current is 250 mA. This is within the rating of the BZY88-C7V5 and is therefore permissible.

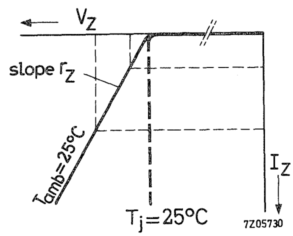
OPERATING NOTES (continued)

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 °C are given on pages 10 and 11 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 $T_j = 25$ °C by a voltage corresponding to $S_Z \times (T_n - 25)$°C, 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 differential resistance, r_Z

(2) the rise in junction temperature due to internal dissipation and the thermal resistance from junction to ambient, $V_Z \cdot I_Z \cdot R_{th\ j\text{-}a}$

(3) the temperature coefficient of the diode, S_Z

From the above, the static slope resistance r_Z is found to be

$$r_Z = r_z + V_Z \cdot R_{th\ j\text{-}a} \cdot S_Z$$

where r_z is the differential resistance, V_Z is the steady-state zener voltage and is equal to

$$\frac{V_Z'}{1 - I_Z \cdot R_{th\ j\text{-}a} \cdot S_Z}$$

V_Z' being the zener voltage at $T_j = T_n$ at the working current I_Z.

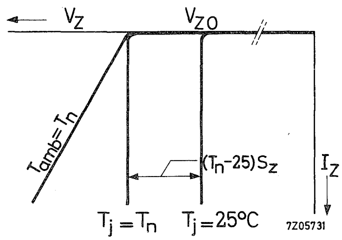
OPERATING NOTES (continued)

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

$$S_Z \times (T_n - 25)^{\circ}C$$

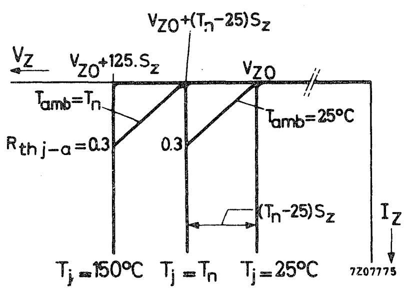
from the low current voltage, V_{ZO} on the dynamic characteristic at T_j = 25 °C (See figure below)

Example for positive S_Z



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.

Example for positive S_Z



Typical static characteristics for each type of diode are given on page 12. These curves were obtained with the device mounted in free air at an ambient temperature of 25 °C.

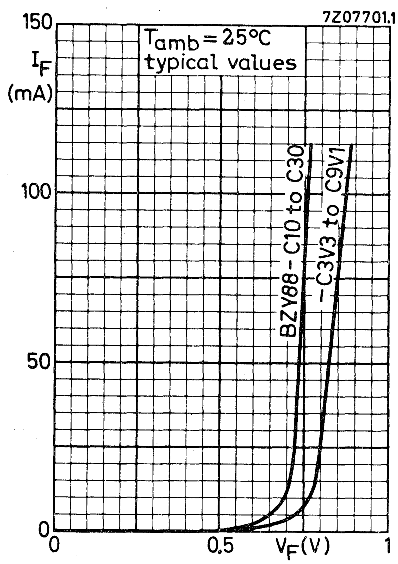
The slope resistance for pulse operation can be calculated by incorporating the transient thermal resistance $R_{th\ t}$ into the formula for r_Z. Curves of $R_{th\ t}$ plotted against pulse duration and duty cycle are given in the lower figure on page 9.

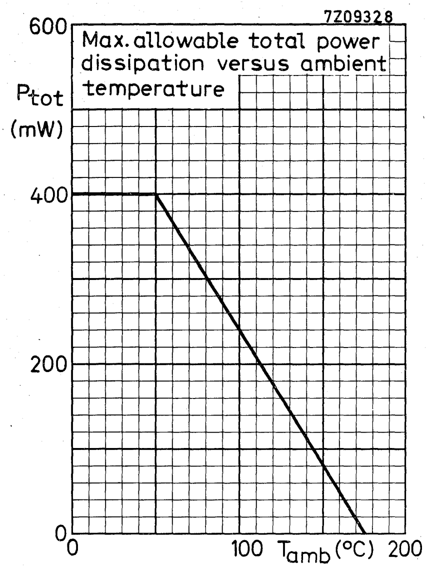
OPERATING NOTES (continued)

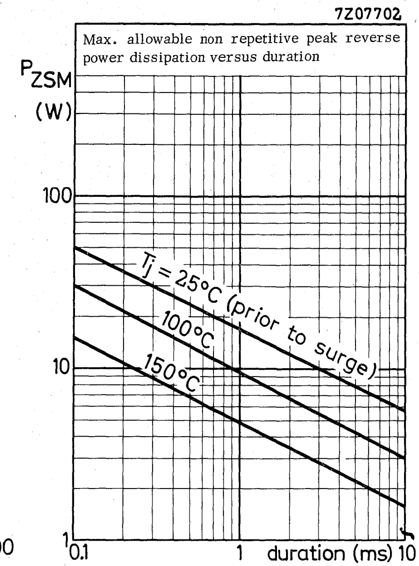
3. When using a soldering iron, the diode may be soldered directly into a circuit, but heat conducted to the junction should be kept to a minimum by use of a thermal shunt.

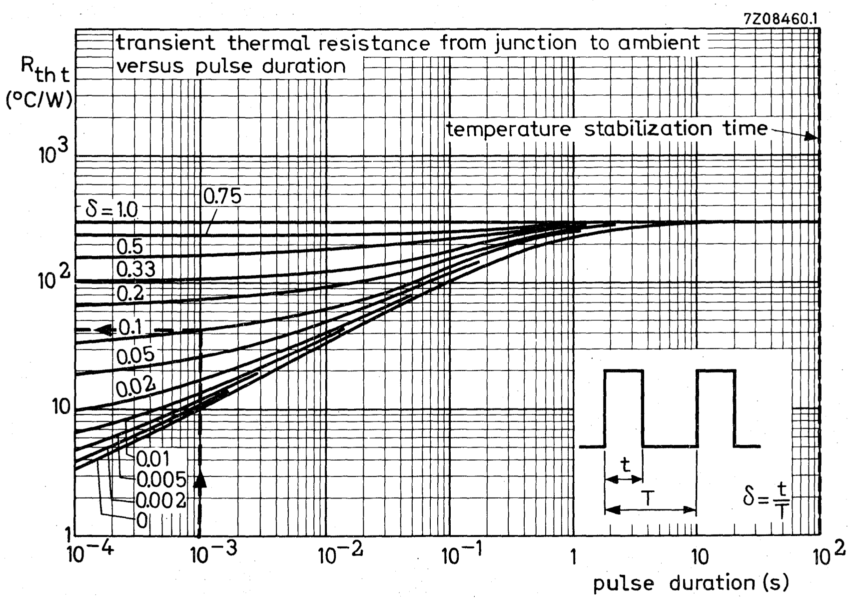
4. Diodes may be dip soldered at a solder temperature of 245 °C for a maximum soldering time of 5 seconds. The case temperature during dip soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a diode with the anode end mounted flush on the board with punched-through holes. For mounting the cathode end onto the board the diode must be spaced 5 mm 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.

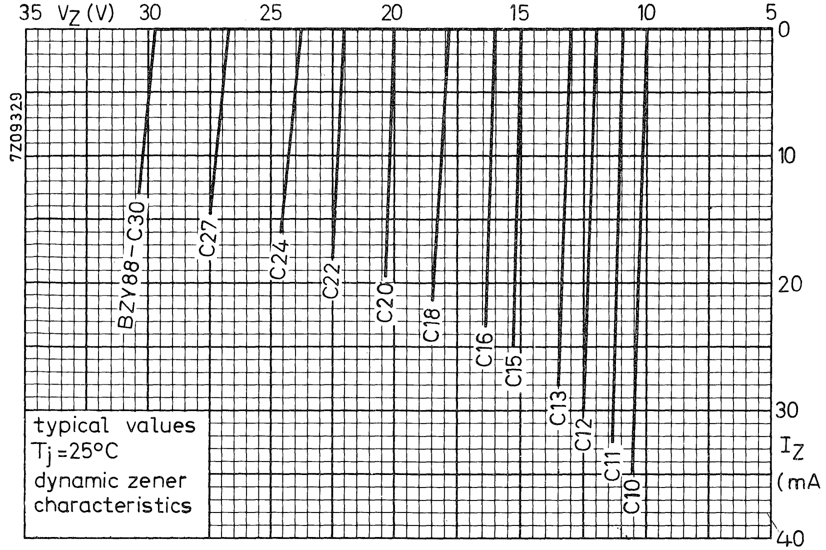
5. Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

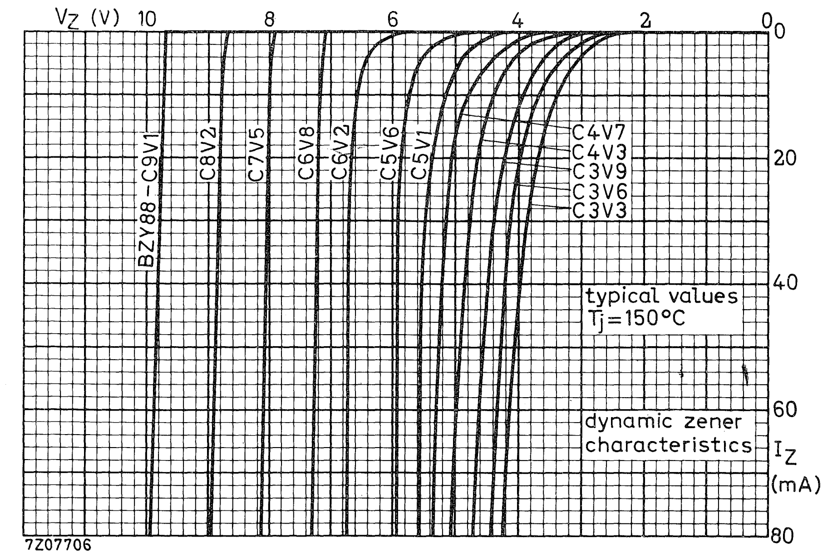


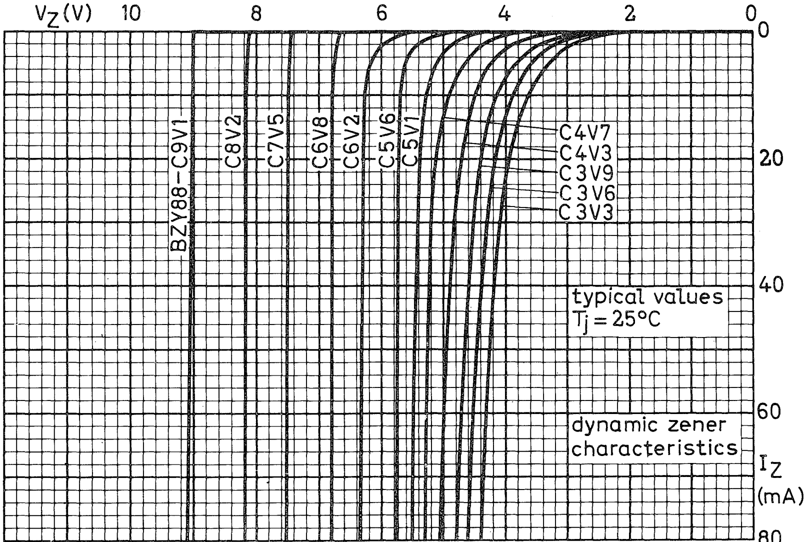

7Z09328
Max. allowable total power dissipation versus ambient temperature
P_{tot} (mW)
600
400
200
0
0
100
T_{amb} (°C)
200


7Z07702
Max. allowable non repetitive peak reverse power dissipation versus duration
P_{ZSM} (W)
100
10
1
0.1
1
duration (ms)
10
T_j = 25 °C (prior to surge)
100 °C
150 °C

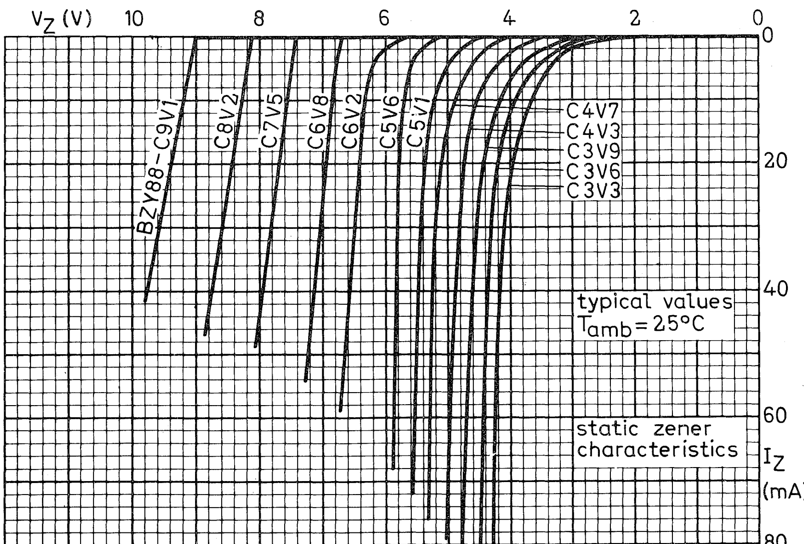

7Z08460.1
transient thermal resistance from junction to ambient versus pulse duration
$R_{th\,t}$ (°C/W)
10^3
10^2
10
1
temperature stabilization time
δ = 1.0
0.75
0.5
0.33
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
pulse duration (s)
t
T
$\delta = \frac{t}{T}$


35 V_Z (V) 30 25 20 15 10 5
0 10 20 30 I_Z (mA) 40
7Z09329
BZY88-C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
C11
C10
typical values
T_j=25°C
dynamic zener characteristics

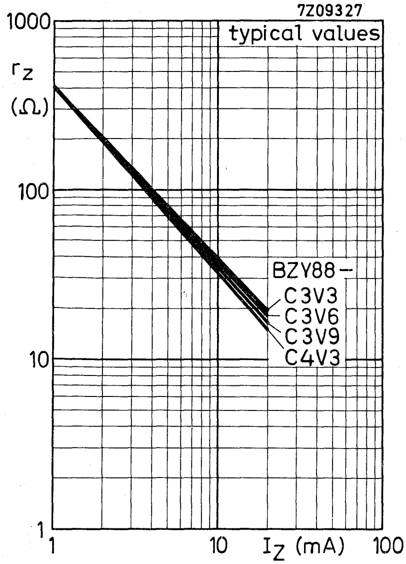

V_Z (V) 10 8 6 4 2 0
0 20 40 60 I_Z (mA) 80
BZY88-C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
C4V3
C3V9
C3V6
C3V3
typical values
T_j=150°C
dynamic zener characteristics
7Z07706

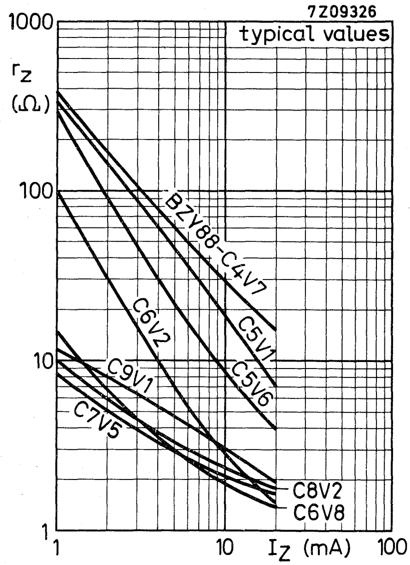


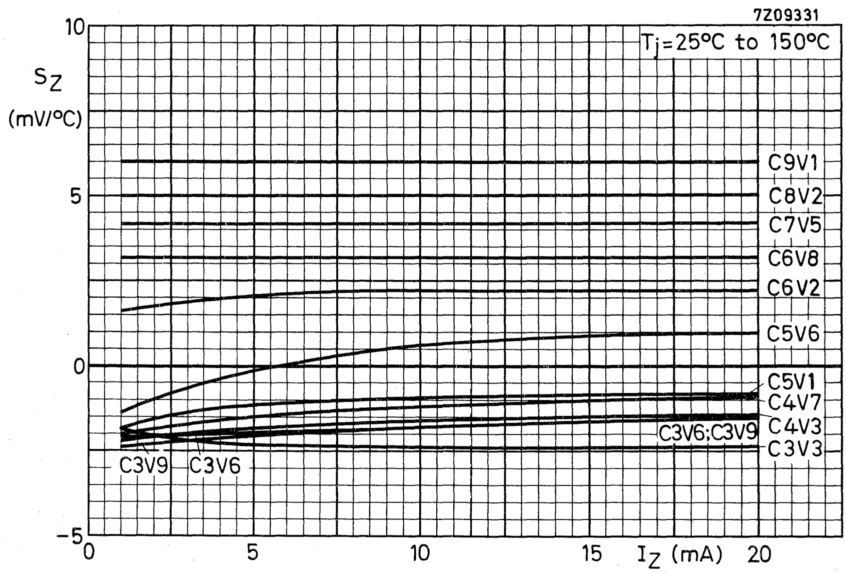
7Z07704

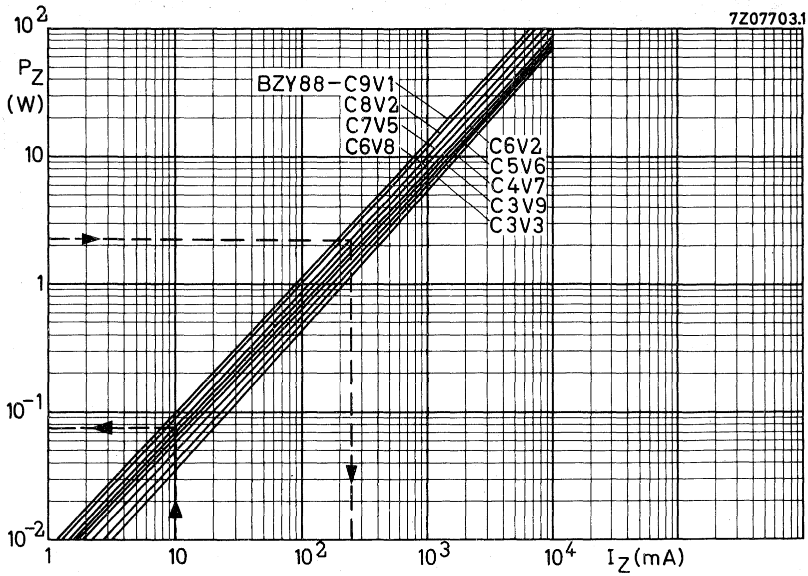


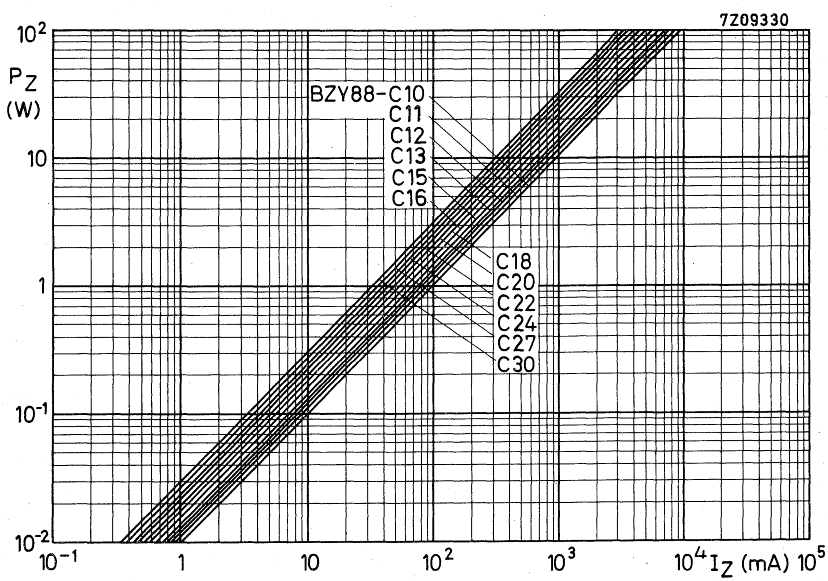
7Z07708


7Z09327
typical values
1000
r_Z
(Ω)
100
10
1
BZY88 –
C3V3
C3V6
C3V9
C4V3
1
10
I_Z (mA)
100


7Z09326
typical values
1000
r_Z
(Ω)
100
10
1
BZY88-C4V7
C5V1
C5V6
C6V2
C9V1
C7V5
C8V2
C6V8
1
10
I_Z (mA)
100


7Z09331
T_j=25°C to 150°C
S_Z
(mV/°C)
10
5
0
−5
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
C4V3
C3V3
C3V6;C3V9
C3V9
C3V6
0
5
10
15
I_Z (mA)
20


7Z07703.1
10^2
P_Z
(W)
10
1
10^{-1}
10^{-2}
1
10
10^2
10^3
10^4
I_Z(mA)
BZY88-C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C4V7
C3V9
C3V3


7Z09330
10^2
P_Z
(W)
10
1
10^{-1}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
I_Z (mA)
10^5
BZY88-C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
C30

VOLTAGE REGULATOR DIODES

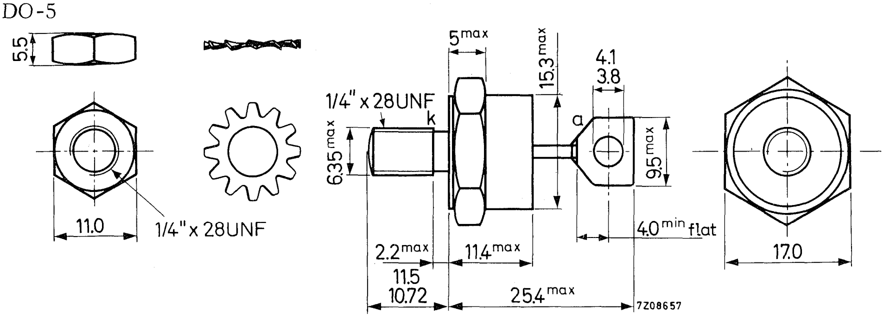
Diffused silicon diodes in a DO-5 envelope for use in power stabilisation and transient suppression circuits.
The series consists of 22 normal polarity types (stud cathode) and 22 reverse polarity types (stud anode) with nominal zener voltages ranging from 10 to 75 V with a tolerance of ±5%.

QUICK REFERENCE DATA

Zener voltage range		nom.	10 to 75	V
Zener voltage tolerance			±5	%
Repetitive peak zener current	I_{ZRM}	max.	100	A
Total power dissipation up to T_{mb} = 65 °C	P_{tot}	max.	75	W
Non repetitive peak reverse power T_{mb} = 65 °C; t = 100 μs	P_{ZSM}	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



Polarity of connections: BZY91-C10 to C75 stud cathode
BZY91-C10R to C75R stud anode

Diameter of hole in heatsink: max. 6.5 mm
Accessories available: 56264A

Torque on nut: min. 17 cm kg
max. 35 cm kg

Net weight : 11 g
With accessories: 15 g

RATINGS (Limiting values) [1]

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	30	A
Repetitive peak zener current	I_{ZRM}	max.	100	A

Power dissipation

Total power dissipation up to $T_{mb} = 65\ ^oC$	P_{tot}	max.	75	W
Non repetitive peak reverse power at $T_{mb} = 65\ ^oC$; $\delta = 0$				
t = 100 μs	P_{ZSM}	max.	4.4	kW
t = 1 ms	P_{ZSM}	max.	1.48	kW
t = 10 ms	P_{ZSM}	max.	500	W
t = 100 ms	P_{ZSM}	max.	170	W

Temperatures

Storage temperature	T_{stg}		-55 to +175	^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.47	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^oC/W$

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

CHARACTERISTICS at T_{mb} = 25 °C

Forward voltage at I_F = 10 A	V_F	< 1.5	V
Reverse current at $V_R = \frac{2}{3} \cdot V_{Znom}$	I_R	< 1	mA

BZY91-...	Zener voltage V_Z at I_Z = 2 A [1]			Differential resistance r_Z at I_Z = 2 A
	min.	nom.	max.	max.
C10(R)	9.4	10	10.6 V	0.4 Ω
C11(R)	10.4	11	11.6 V	0.4 Ω
C12(R)	11.4	12	12.6 V	0.5 Ω
C13(R)	12.4	13	14.1 V	0.5 Ω
C15(R)	13.9	15	15.6 V	0.6 Ω
C16(R)	15.4	16	17.1 V	0.6 Ω
C18(R)	16.9	18	19.1 V	0.7 Ω
	at I_Z = 1 A [1]			at I_Z = 1 A
	min.	nom.	max.	max.
C20(R)	18.9	20	21.2 V	0.8 Ω
C22(R)	20.8	22	23.3 V	0.8 Ω
C24(R)	22.7	24	25.9 V	0.9 Ω
C27(R)	25.1	27	28.9 V	1.0 Ω
C30(R)	28	30	32 V	1.1 Ω
C33(R)	31	33	35 V	1.2 Ω
C36(R)	34	36	38 V	1.3 Ω
	at I_Z = 0.5 A [1]			at I_Z = 0.5 A
	min.	nom.	max.	max.
C39(R)	37	39	41 V	1.4 Ω
C43(R)	40	43	45 V	1.5 Ω
C47(R)	44	47	50 V	1.7 Ω
C51(R)	48	51	54 V	1.8 Ω
C56(R)	53	56	60 V	2.0 Ω
C62(R)	58	62	66 V	2.2 Ω
C68(R)	64	68	72 V	2.4 Ω
C75(R)	71	75	79 V	2.6 Ω

[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

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 $^{o}C/W$,

   $R_{th\ h\text{-}a}$ is the thermal resistance of the heatsink

   b. Pulse conditions (see fig. next page)

   The maximum allowable additional pulse power $P_{m\ max.}$ is given by the formula

$$P_{m\ max.} = \frac{(T_{j\ max.} - T_{amb}) - (P_s \cdot R_{th\ j\text{-}a})}{R_{th\ t} + \delta \cdot R_{th\ mb\ a}}$$

   where P_s is the steady-state dissipation, excluding that in the pulses,

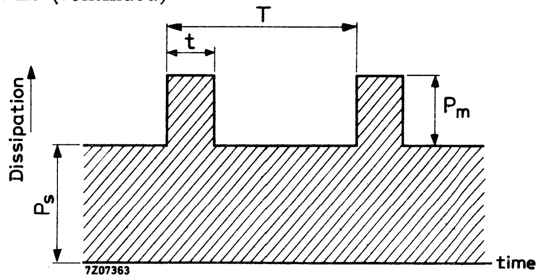
   $R_{th\ t}$ is the effective transient thermal resistance of the device from junction to mounting base. It is a function of the pulse duration t and duty cycle δ (see page 8),

   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. $R_{th\ mb\text{-}a} = R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$.

The steady-state power P_s when biased in the zener direction at a given zener current can be found from page 9, upper figure. With the additional pulsed power dissipation P_m calculated from the above expression, the total repetitive peak zener power dissipation $P_{ZRM} = P_s + P_m$. From page 9, upper figure the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive 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 repetitive peak dissipation P_{ZRM} is equal to the maximum steady-state power $P_{s\ max.}$ The temperature stabilisation time for the BZY91series is 2 s (see page 8).

OPERATING NOTES (continued)



2. Care must be taken to ensure that the connecting lug is not bent or twisted.

Example

The following example illustrates how to calculate the maximum permissible repetitive peak zener current of a BZY91-C56 zener diode mounted on a heatsink with $R_{th\ h\text{-}a} = 2\ ^oC/W$ at a maximum ambient temperature of 50 ^oC. The steady-state zener current is 0.5 A, the duty cycle $\delta = 0.1$ and the pulse duration $t = 1$ ms.

The steady-state dissipation P_S at a zener current of 0.5 A (from page 9, upper figure) = 28 W.
The thermal resistance from junction to ambient $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = 1.47 + 0.2 + 2 = 3.67\ ^oC/W$.
The transient thermal resistance $R_{th\ t}$ with a duty cycle $\delta = 0.1$ and a pulse duration $t = 1$ ms (from page 8, lower figure)

$$R_{th\ t} = 0.23\ ^oC/W$$

The maximum additional pulse power dissipation

$$P_{m\ max.} = \frac{(T_{j\ max} - T_{amb}) - P_S \cdot R_{th\ j\text{-}a}}{R_{th\ t} + \delta \cdot R_{th\ mb\text{-}a}}$$

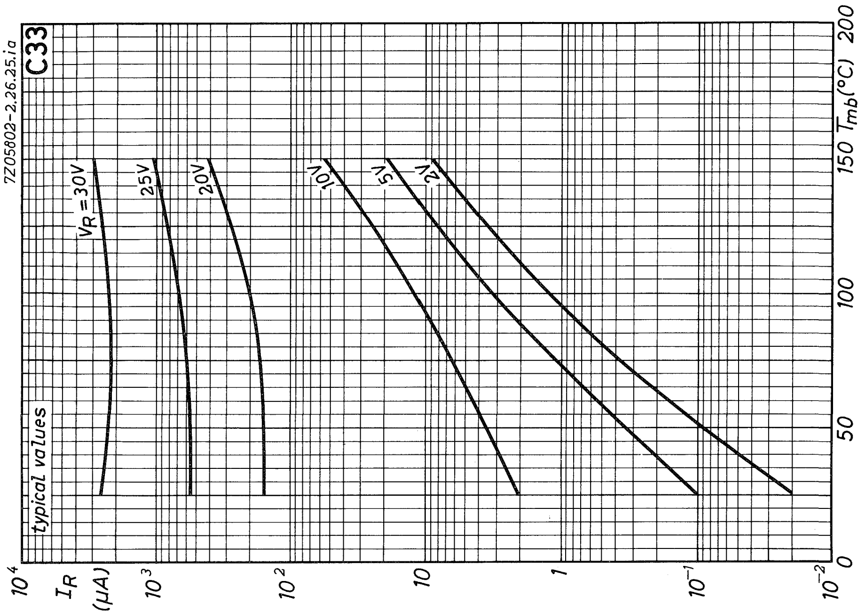
If $P_S = 28$ W, $R_{th\ t} = 0.23\ ^oC/W$,

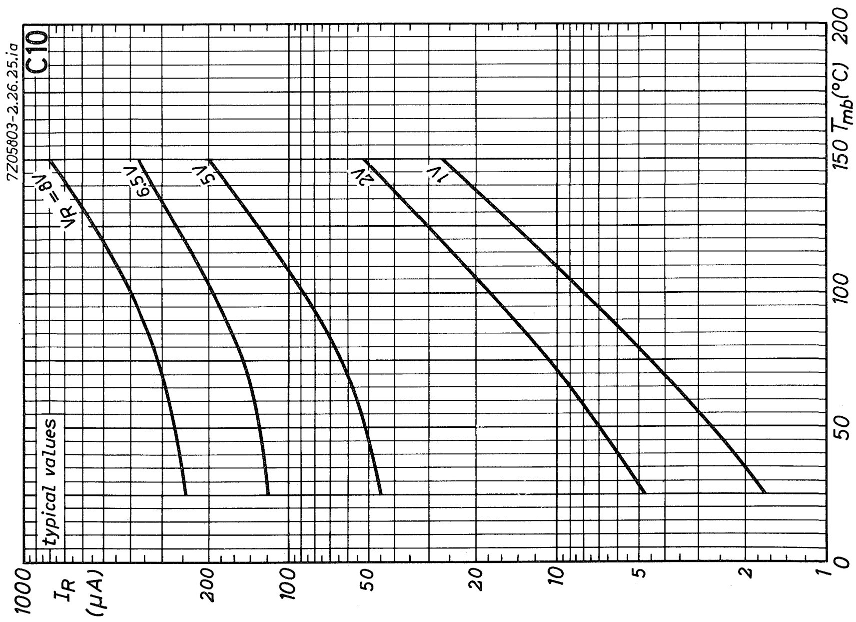
then
$$P_{m\ max} = \frac{(175 - 50) - (28 \times 3.67)}{0.23 + 0.1 \times 2.2} = 49\ W$$

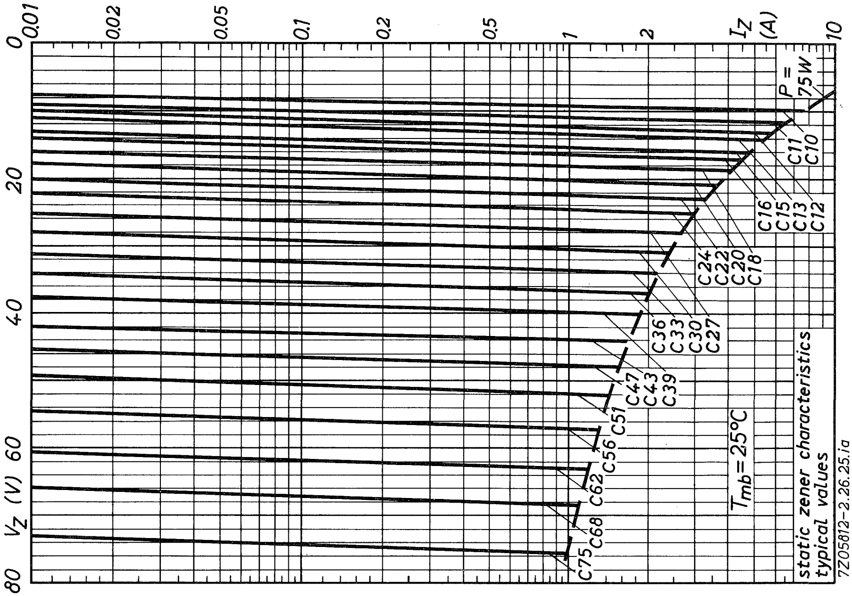
therefore, the total repetitive peak power dissipation,

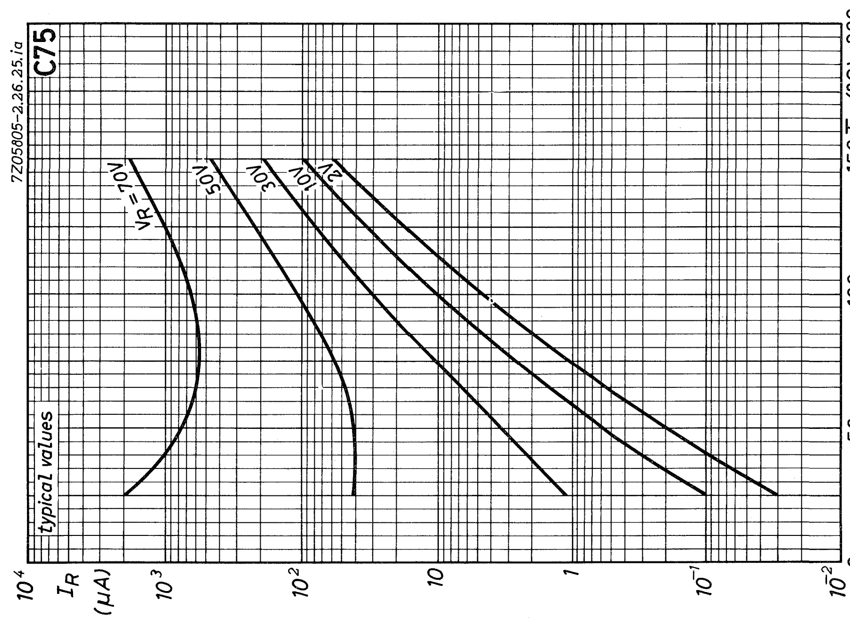
$$P_{ZRM} = (28\ W + 49\ W) = 77\ W$$

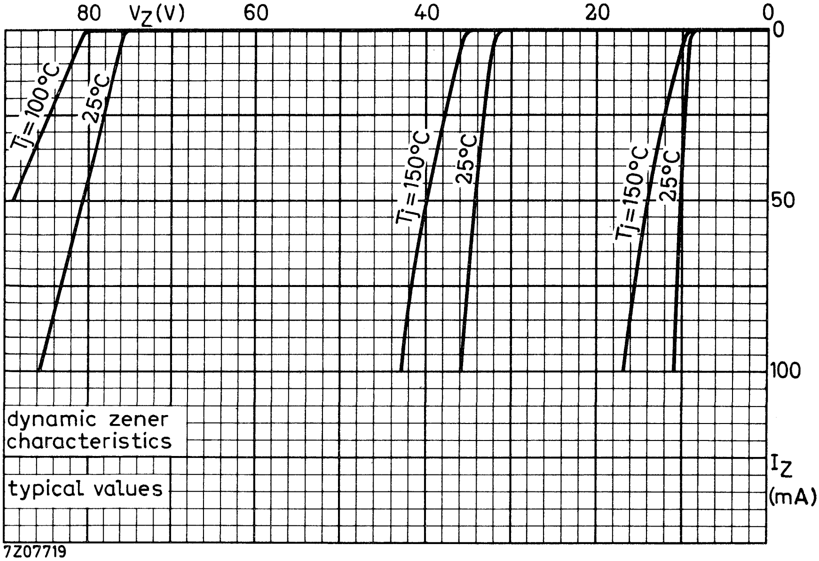
From page 9, upper figure, the corresponding repetitive peak zener current is 1.3 A. This is within the rating of the BZY91-C56 and is therefore permissible.

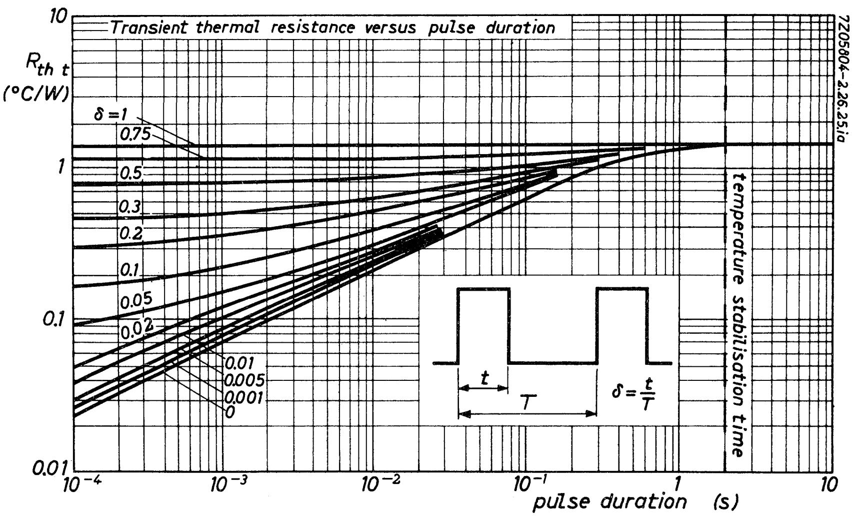

7Z05802-2.26.25.ia
C33
typical values
$V_R = 30V$
25V
20V
10V
5V
2V
I_R (μA)
10^4
10^3
10^2
10
1
10^{-1}
10^{-2}
0
50
100
150
200
T_{mb} (°C)

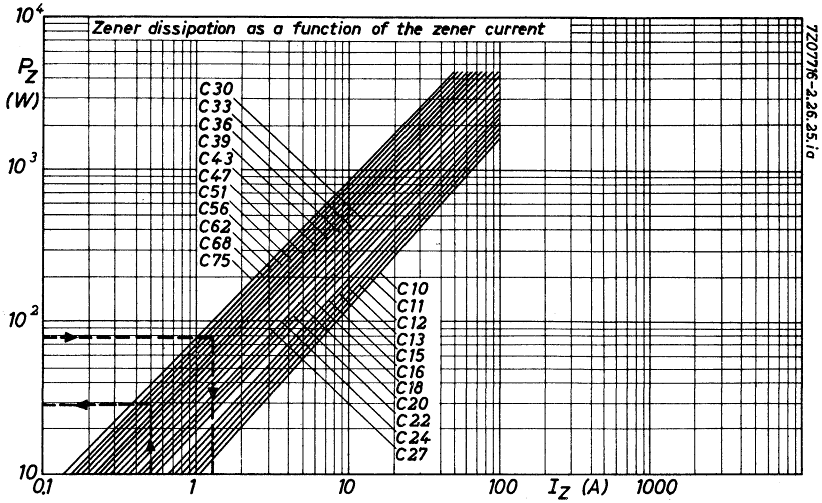

7Z05803-2.26.25.ia
C10
typical values
$V_R = 8V$
6.5V
5V
2V
1V
I_R (μA)
1000
200
100
50
20
10
5
2
1
0
50
100
150
200
T_{mb} (°C)

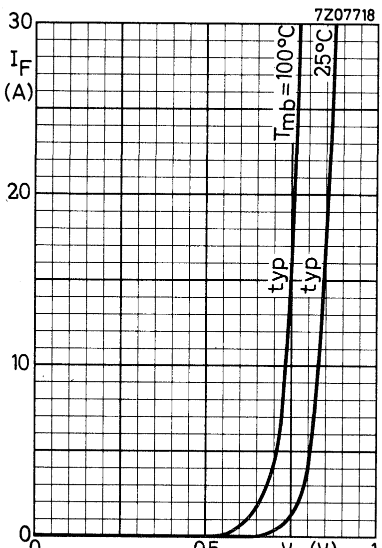

I_Z (A)
V_Z (V)
P = 75W
C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
C30
C33
C36
C39
C43
C47
C51
C56
C62
C68
C75
T_mb = 25°C
static zener characteristics
typical values
7Z05812-2.26.25.ia

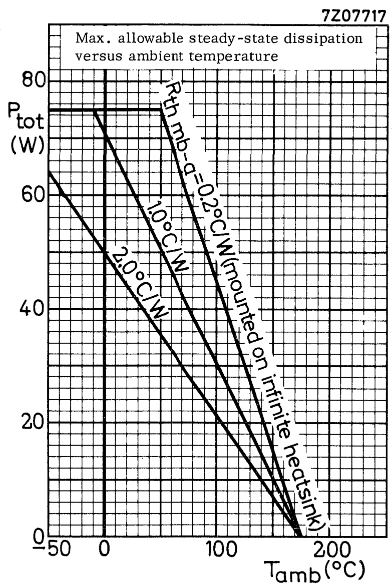

C75
typical values
7Z05805-2.26.25.ia
I_R (μA)
T_mb (°C)
V_R = 70V
50V
30V
10V
2V

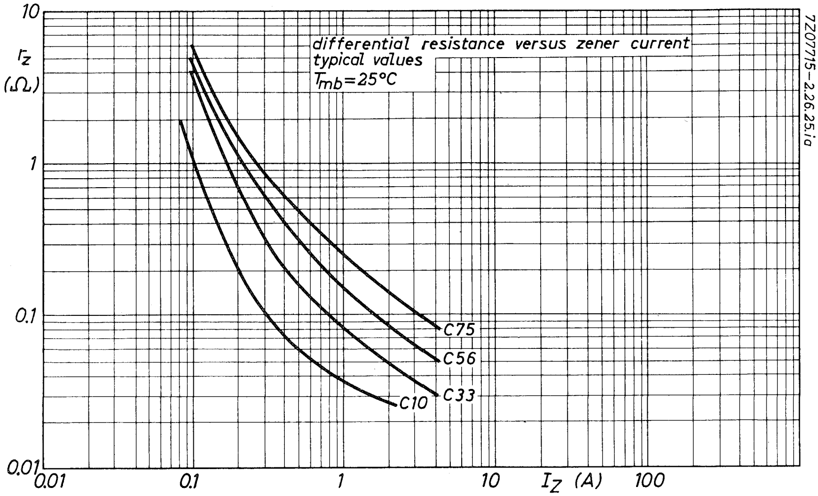

80
V_Z(V)
60
40
20
0
0
50
100
T_j=100°C
25°C
T_j=150°C
25°C
T_j=150°C
25°C
dynamic zener
characteristics
typical values
I_Z
(mA)
7Z07719

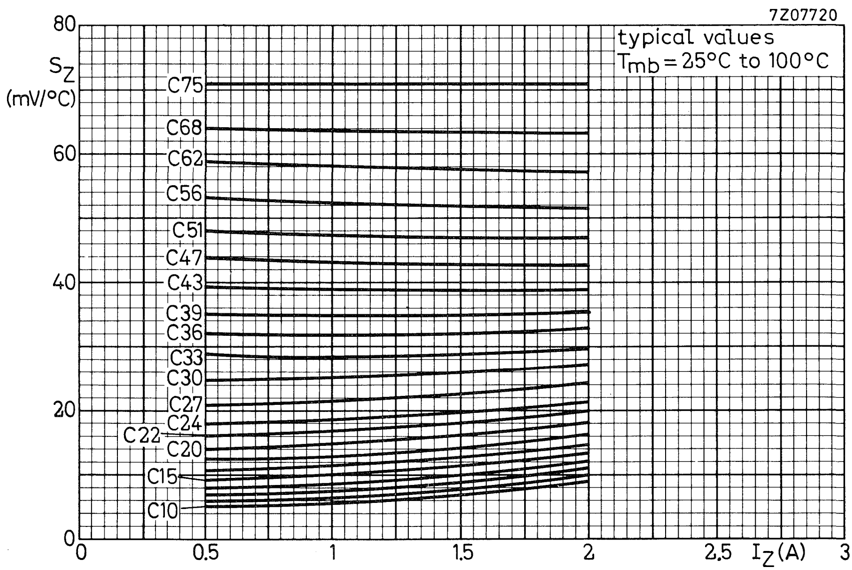

Transient thermal resistance versus pulse duration
7Z05804-2.26.25.ia
$R_{th\ t}$
(°C/W)
10
1
0.1
0.01
δ = 1
0.75
0.5
0.3
0.2
0.1
0.05
0.02
0.01
0.005
0.001
0
t
T
δ = t/T
temperature stabilisation time
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
pulse duration (s)


Zener dissipation as a function of the zener current
7Z07716-2.26.25.1a
P_Z (W)
10^4
10^3
10^2
10
0.1
1
10
100
1000
I_Z (A)
C30
C33
C36
C39
C43
C47
C51
C56
C62
C68
C75
C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27


7Z07718
I_F (A)
30
20
10
0
0.5
1
V_F (V)
T_{mb}=100°C
25°C
typ
typ


7Z07717
Max. allowable steady-state dissipation versus ambient temperature
P_{tot} (W)
80
60
40
20
0
−50
0
100
200
T_{amb} (°C)
$R_{th\ mb-a}$=0.2°C/W (mounted on infinite heatsink)
1.0°C/W
2.0°C/W


7Z07715–2.26.25.ia
differential resistance versus zener current
typical values
$T_{mb} = 25°C$
r_z (Ω)
10
1
0.1
0.01
C75
C56
C33
C10
0.01
0.1
1
10
I_Z (A)
100


7Z07720
typical values
$T_{mb} = 25°C$ to 100°C
S_Z (mV/°C)
80
60
40
20
0
C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
C30
C27
C24
C22
C20
C15
C10
0
0.5
1
1.5
2
2.5
I_Z (A)
3

SILICON POWER VOLTAGE REGULATORS

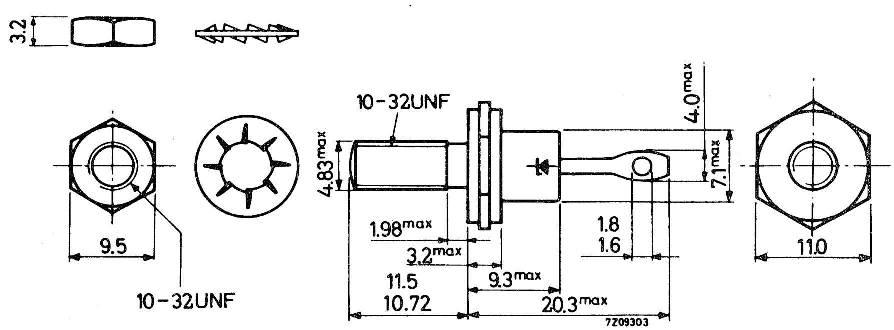
Diffused silicon diodes in a DO-4 metal envelope intended for general purpose applications.
The series consists of 25 normal polarity types (stud cathode) and 25 reverse polarity types (stud anode) with nominal zener voltages ranging from 7.5 V to 75 V with a tolerance of ±5%.

QUICK REFERENCE DATA

Zener voltage range		nom.	7.5 to 75	V
Zener voltage tolerance			±5	%
Repetitive peak zener current	I_{ZRM}	max.	20	A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	20	W
Non repetitive peak reverse power dissipation T_j = 175 °C; t = 100 μs	P_{ZSM}	max.	500	W
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	5.0	°C/W

MECHANICAL DATA Dimensions in mm

DO-4



Net weight : 4.3 g
With accessories: 6.5 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295 (56262A)

Torque on nut: min. 8 cm kg
max. 17 cm kg
The mark shown applies to normal polarity types

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

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	5	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Repetitive peak zener current	I_{ZRM}	max.	20	A

Power dissipation

Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	20	W
Non repetitive peak reverse power dissipation, T_j = 175 °C; t = 100 μs	P_{ZSM}	max.	500	W

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.6	°C/W

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 5 A V_F < 1.5 V

Reverse current at

			BZY93- C7V5(R)	C8V2(R)	C9V1(R) to C75(R)	
V_R = 2 V	I_R	<	100			μA
V_R = 5.6 V	I_R	<		100		μA
$V_R = \frac{2}{3} \cdot V_{Znom}$	I_R	<			50	μA

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

BZY93-...	Zener voltage V_Z min.	nom.	max.	Temperature coefficient typ.	Differential resistance typ.	max.
	at I_Z = 2 A			at I_Z = 2 A	at I_Z = 2 A	
C7V5(R)	7.1	7.5	7.9 V	3.0 mV/°C	0.04	0.3 Ω
C8V2(R)	7.7	8.2	8.7 V	4.0 mV/°C	0.05	0.3 Ω
	at I_Z = 1 A			at I_Z = 1 A	at I_Z = 1 A	
	min.	nom.	max.	typ.	typ.	max.
C9V1(R)	8.6	9.1	9.6 V	5.0 mV/°C	0.07	0.5 Ω
C10(R)	9.4	10	10.6 V	7.0 mV/°C	0.07	0.5 Ω
C11(R)	10.4	11	11.6 V	7.5 mV/°C	0.08	1.0 Ω
C12(R)	11.4	12	12.6 V	8.0 mV/°C	0.08	1.0 Ω
C13(R)	12.4	13	14.1 V	8.5 mV/°C	0.08	1.0 Ω
C15(R)	13.9	15	15.6 V	10.0 mV/°C	0.10	1.2 Ω
	at I_Z = 0.5 A			at I_Z = 0.5 A	at I_Z = 0.5 A	
	min.	nom.	max.	typ.	typ.	max.
C16(R)	15.4	16	17.1 V	11 mV/°C	0.18	1.2 Ω
C18(R)	16.9	18	19.1 V	12 mV/°C	0.20	1.5 Ω
C20(R)	18.9	20	21.2 V	14 mV/°C	0.20	1.5 Ω
C22(R)	20.8	22	23.3 V	16 mV/°C	0.21	1.8 Ω
C24(R)	22.7	24	25.9 V	18 mV/°C	0.22	2.0 Ω
C27(R)	25.1	27	28.9 V	21 mV/°C	0.25	2.0 Ω
C30(R)	28	30	32 V	25 mV/°C	0.30	2.5 Ω
C33(R)	31	33	35 V	30 mV/°C	0.32	3.0 Ω
	at I_Z = 0.2 A			at I_Z = 0.2 A	at I_Z = 0.2 A	
	min.	nom.	max.	typ.	typ.	max.
C36(R)	34	36	38 V	32 mV/°C	0.75	4.0 Ω
C39(R)	37	39	41 V	35 mV/°C	0.85	5.0 Ω
C43(R)	40	43	45 V	40 mV/°C	0.90	6.5 Ω
C47(R)	44	47	50 V	45 mV/°C	1.0	7.0 Ω
C51(R)	48	51	54 V	50 mV/°C	1.2	7.5 Ω
C56(R)	53	56	60 V	55 mV/°C	1.3	8.0 Ω
C62(R)	58	62	66 V	60 mV/°C	1.5	9.0 Ω
C68(R)	64	68	72 V	65 mV/°C	1.8	10.0 Ω
C75(R)	71	75	79 V	70 mV/°C	2.0	10.5 Ω

OPERATING NOTES

1. Dissipation and heatsink considerations

   a. Steady-state conditions

   The maximum allowable steady-state dissipation $P_{s\,max}$ 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 $0.6\ ^{o}C/W$,

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

   b. Pulse conditions (see fig. next page)

   The maximum allowable additional pulse power $P_{m\,max}$ is given by the formula

$$P_{m\,max} = \frac{(T_{j\,max} - T_{amb}) - (P_s \,.\, R_{th\,j\text{-}a})}{R_{th\,t} + \delta \,.\, R_{th\,mb\text{-}a}}$$

   where P_s is the steady-state dissipation, excluding that in the pulses,

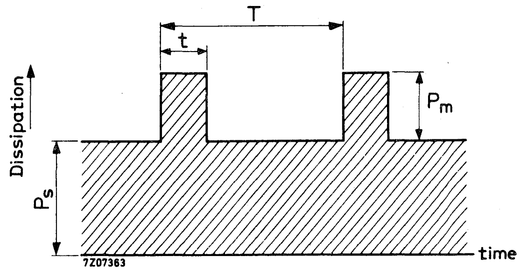
   $R_{th\,t}$ is the effective transient thermal resistance of the device from junction to mounting base. It is a function of the pulse duration t and duty cycle δ (see page 6, upper figure).

   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. $R_{th\,mb\text{-}a} = R_{th\,mb\text{-}h} + R_{th\,h\text{-}a}$.

The steady-state power P_s when biased in the zener direction at a given zener current can be found from page 8, upper figure. With the additional pulsed power dissipation $P_{m\,max}$ calculated from the above expression, the total repetitive peak zener power dissipation $P_{ZRM} = P_s + P_{m\,max}$. From page 8, upper figure the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive 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 repetitive peak dissipation P_{ZRM} is equal to the maximum steady-state power $P_{s\,max}$. The temperature stabilisation time for the BZY93series is 5 s (see page 6, upper figure).

OPERATING NOTES (continued)



2. Care must be taken to ensure that the connecting lug is not bent or twisted.

Example

The following example illustrates how to calculate the maximum permissible repetitive peak zener current of a BZY93-C12 zener diode mounted on a heatsink with $R_{th\ h\text{-}a}$ = 2 °C/W at a maximum ambient temperature of 50 °C. The steady-state zener current is 0.5 A, the duty cycle δ = 0.1 and the pulse duration t = 1 ms.

The steady-state dissipation P_S at a zener current of 0.5 A (from page 8, upper figure) = 7 W.
The thermal resistance from junction to ambient $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = 5 + 0.6 + 2 = 7.6$ °C/W.
The transient thermal resistance $R_{th\ t}$ with a duty cycle δ = 0.1 and a pulse duration t = 1 ms (from page 6, upper figure)

$$R_{th\ t} = 0.92\ ^{o}\mathrm{C/W}$$

The maximum additional pulse power dissipation

$$P_{m\ max} = \frac{(T_{j\ max} - T_{amb}) - P_S \cdot R_{th\ j\text{-}a}}{R_{th\ t} + \delta \cdot R_{th\ mb\text{-}a}}$$

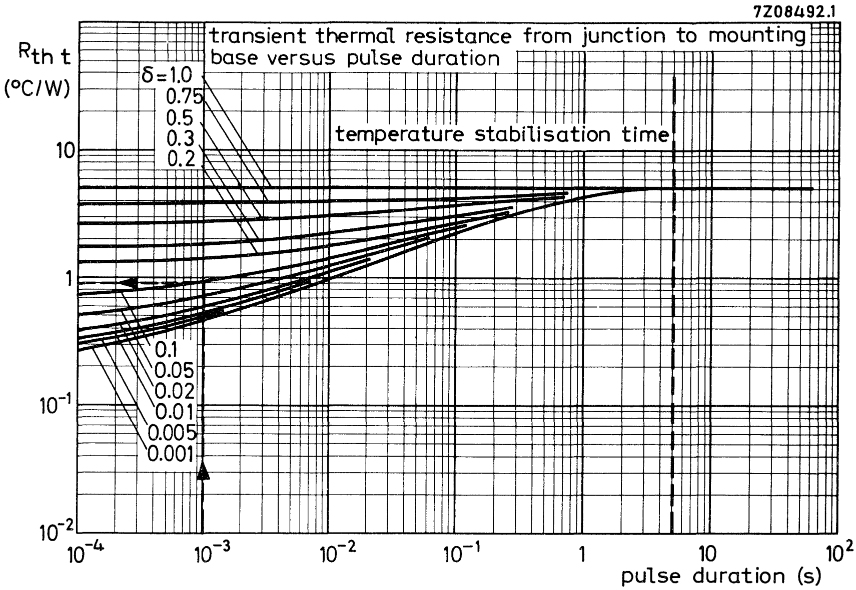
If P_S = 7 W, $R_{th\ t}$ = 0.92 °C/W,

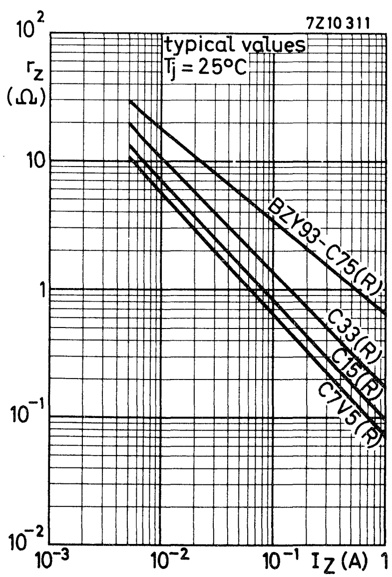
$$P_{m\ max} = \frac{(175 - 50) - (7 \times 7.6)}{0.92 + 0.1 \times 2.6} = 61\ \mathrm{W}$$

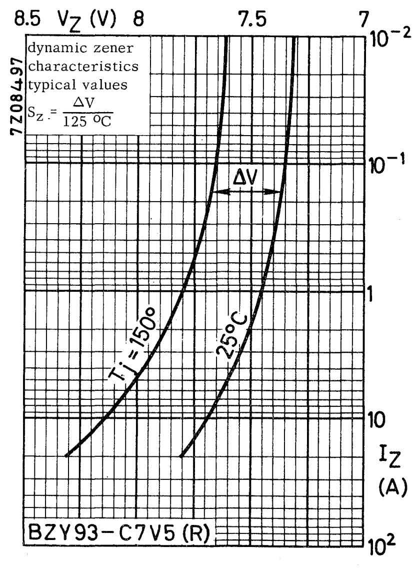
therefore, the total repetitive peak power dissipation,

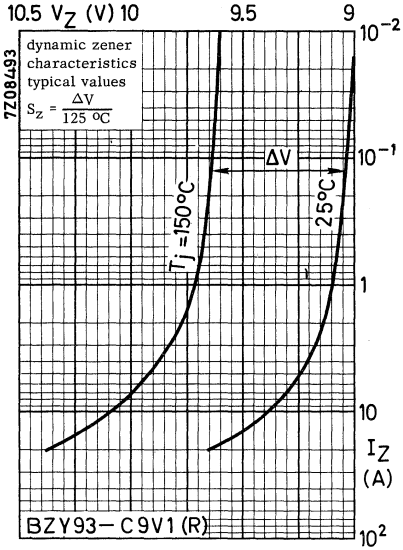
$$P_{ZRM} = (7 + 61) = 68\ \mathrm{W}$$

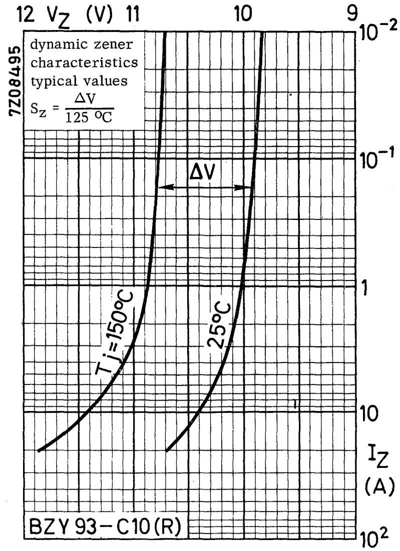
From page 8, upper figure, the corresponding repetitive peak zener current is 5 A. This is within the rating of the BZY93-C12 and is therefore permissible.

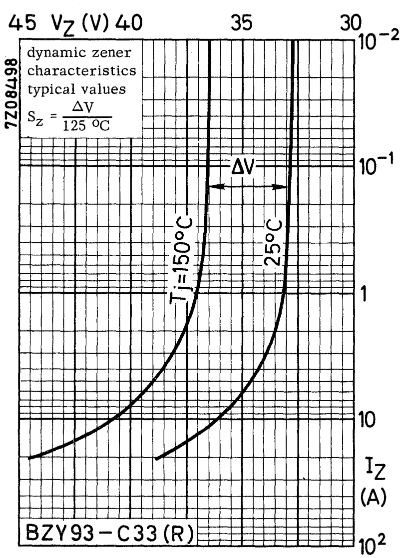

7Z08492.1
transient thermal resistance from junction to mounting base versus pulse duration
$R_{th\ t}$ (°C/W)
δ = 1.0
0.75
0.5
0.3
0.2
temperature stabilisation time
0.1
0.05
0.02
0.01
0.005
0.001
10
1
10^{-1}
10^{-2}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
pulse duration (s)

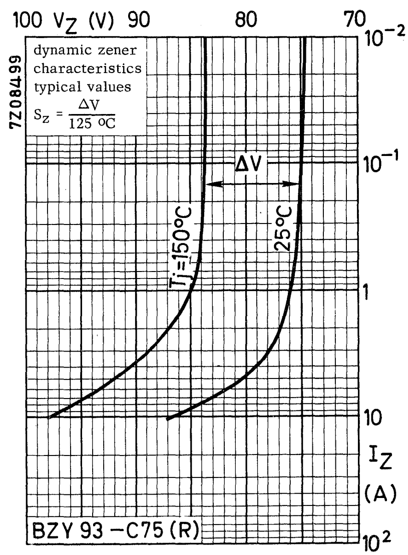

7Z10311
typical values
T_j = 25°C
r_z (Ω)
BZY93-C75(R)
C33(R)
C15(R)
C7V5(R)
10^{2}
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-2}
10^{-1}
I_Z (A)
1


7Z08497
dynamic zener characteristics typical values
$S_Z = \frac{\Delta V}{125\ ^{\circ}C}$
8.5
V_Z (V)
8
7.5
7
ΔV
T_j = 150°
25°C
10^{-2}
10^{-1}
1
10
10^{2}
I_Z (A)
BZY93-C7V5 (R)

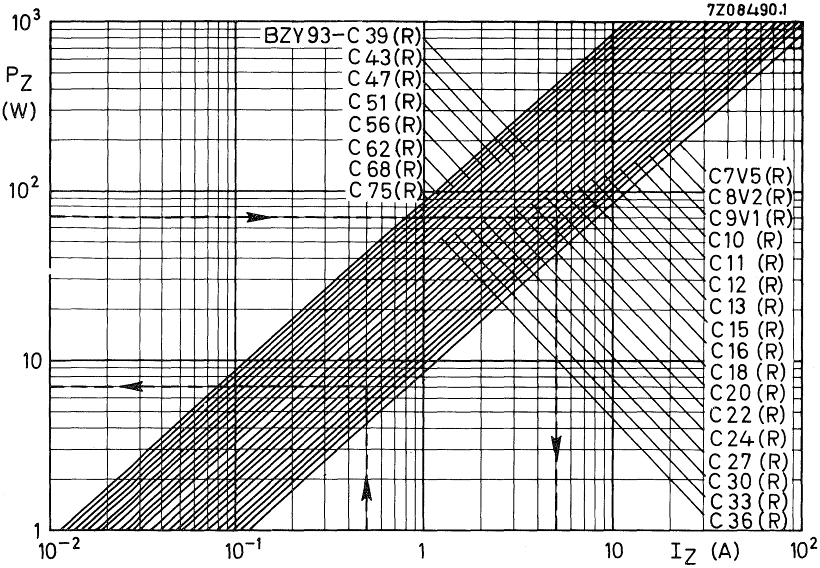

10.5 V_Z (V) 10 9.5 9
7Z08493
dynamic zener characteristics typical values
$S_z = \frac{\Delta V}{125\ ^oC}$
ΔV
T_j =150°C
25°C
10^{-2} 10^{-1} 1 10 10^2
I_Z (A)
BZY93 – C9V1 (R)


12 V_Z (V) 11 10 9
7Z08495
dynamic zener characteristics typical values
$S_z = \frac{\Delta V}{125\ ^oC}$
ΔV
T_j=150°C
25°C
10^{-2} 10^{-1} 1 10 10^2
I_Z (A)
BZY 93 – C10 (R)

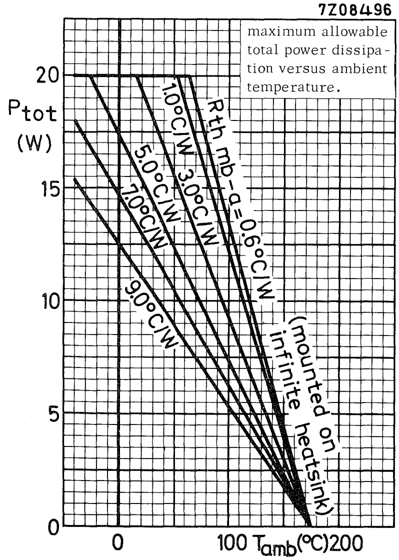

45 V_Z (V) 40 35 30
7Z08498
dynamic zener characteristics typical values
$S_z = \frac{\Delta V}{125\ ^oC}$
ΔV
T_j=150°C
25°C
10^{-2} 10^{-1} 1 10 10^2
I_Z (A)
BZY93 – C33 (R)


100 V_Z (V) 90 80 70
7Z08499
dynamic zener characteristics typical values
$S_z = \frac{\Delta V}{125\ ^oC}$
ΔV
T_j=150°C
25°C
10^{-2} 10^{-1} 1 10 10^2
I_Z (A)
BZY 93 – C75 (R)

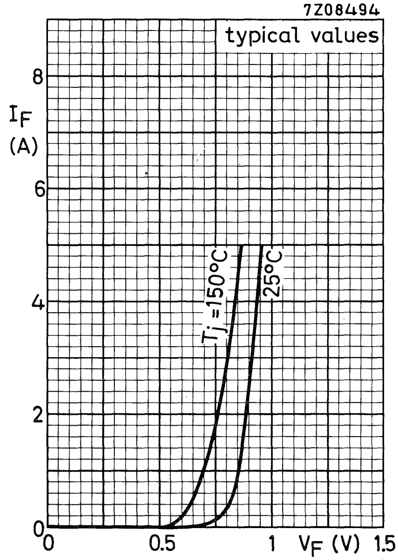
7Z08490.1



7Z08496



7Z08494



MEDIUM POWER VOLTAGE REGULATORS

Diffused silicon diodes in a DO-1 metal case for use as medium power voltage stabilisers or voltage references.
The series consist of 22 normal polarity types (stud-cathode) with nominal zener voltages ranging from 10 V to 75 V with a tolerance of ± 5%.

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

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	1	A
Repetitive peak forward current	I_{FRM}	max.	3	A
Repetitive peak zener current	I_{ZRM}	max.	5	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5	W
Non repetitive peak reverse power	P_{ZSM}	max.	100	W

Temperatures

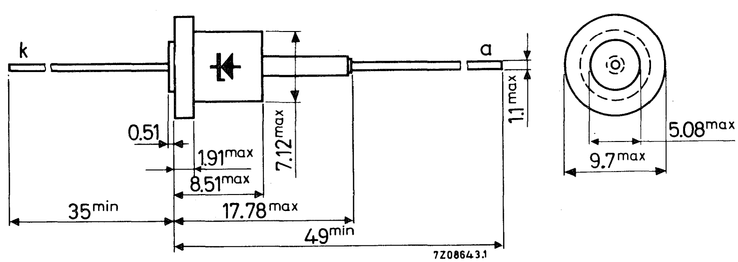
Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	100	°C/W

MECHANICAL DATA Dimensions in mm

DO-1



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

Forward voltage at $I_F = 1.0$ A — $V_F < 1.5$ V

Reverse current at $V_R = \frac{2}{3} \cdot V_{Z\,nom}$ — $I_R < 10\ \mu A$

BZY95-...	Zener voltage at I_Z = 50 mA			Temperature coefficient at I_Z = 50 mA	Differential resistance at I_Z = 50 mA	
	min.	nom.	max.	typ.	typ.	max.
C10	9.4	10	10.6 V	7.0 mV/°C	0.75	4.0 Ω
C11	10.4	11	11.6 V	7.5 mV/°C	0.80	4.5 Ω
C12	11.4	12	12.6 V	8.0 mV/°C	0.85	5.0 Ω
C13	12.4	13	14.1 V	8.5 mV/°C	0.90	6.0 Ω
C15	13.9	15	15.6 V	10.0 mV/°C	1.0	8.0 Ω
	at I_Z = 20 mA			at I_Z = 20 mA	at I_Z = 20 mA	
	min.	nom.	max.	typ.	typ.	max.
C16	15.4	16	17.1 V	11 mV/°C	2.4	9 Ω
C18	16.9	18	19.1 V	12 mV/°C	2.5	11 Ω
C20	18.9	20	21.2 V	14 mV/°C	2.8	12 Ω
C22	20.8	22	23.3 V	16 mV/°C	3.0	13 Ω
C24	22.7	24	25.9 V	18 mV/°C	3.4	14 Ω
C27	25.1	27	28.9 V	20 mV/°C	3.8	18 Ω
C30	28	30	32 V	25 mV/°C	4.5	22 Ω
C33	31	33	35 V	30 mV/°C	5.0	25 Ω
C36	34	36	38 V	32 mV/°C	5.5	30 Ω
	at I_Z = 10 mA			at I_Z = 10 mA	at I_Z = 10 mA	
	min.	nom.	max.	typ.	typ.	max.
C39	37	39	41 V	35 mV/°C	12	35 Ω
C43	40	43	45 V	40 mV/°C	13	40 Ω
C47	44	47	50 V	45 mV/°C	14	50 Ω
C51	48	51	54 V	50 mV/°C	15	55 Ω
C56	53	56	60 V	55 mV/°C	17	63 Ω
C62	58	62	66 V	60 mV/°C	18	75 Ω
C68	64	68	72 V	65 mV/°C	18	90 Ω
C75	71	75	79 V	70 mV/°C	20	100 Ω

MEDIUM POWER VOLTAGE REGULATORS

Alloyed silicon diodes in a DO-1 metal case for use as medium power voltage stabilisers or voltage references.
The series consists of 8 normal polarity types (stud-cathode) with nominal zener voltages ranging from 4.7 V to 9.1 V with a tolerance of ±5%.

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

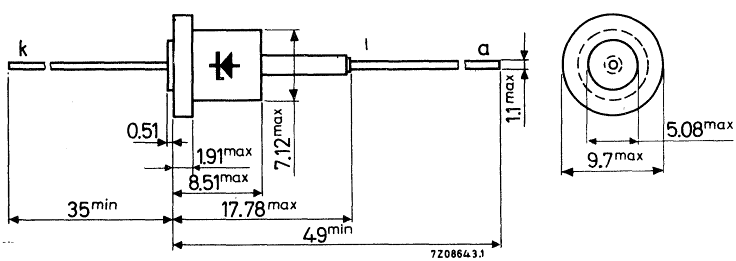
Currents				
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	1	A
Repetitive peak forward current	I_{FRM}	max.	3	A
Repetitive peak zener current	I_{ZRM}	max.	3.5	A
Power dissipation				
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	1.5	W
Non repetitive peak reverse power	P_{ZSM}	max.	20	W
Temperatures				
Storage temperature	T_{stg}		-65 to +175	^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	100	$^oC/W$

MECHANICAL DATA Dimensions in mm

DO-1



CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 1.0 A — V_F < 1.5 V

Reverse current

BZY96-C4V7	V_R = 1.0 V	I_R <	20 μA
C5V1	V_R = 1.0 V	I_R <	20 μA
C5V6	V_R = 1.0 V	I_R <	20 μA
C6V2	V_R = 2.0 V	I_R <	20 μA
C6V8	V_R = 2.0 V	I_R <	20 μA
C7V5	V_R = 3.0 V	I_R <	20 μA
C8V2	V_R = 5.6 V	I_R <	20 μA
C9V1	V_R = 6.2 V	I_R <	20 μA

BZY96-...	Zener voltage at I_Z = 100 mA			Temperature coefficient at I_Z = 100 mA	Differential resistance at I_Z = 100 mA	
	min.	nom.	max.	typ.	typ.	max.
C4V7	4.4	4.7	5.0 V	−0.6 mV/°C	2.5	10 Ω
C5V1	4.8	5.1	5.4 V	+0.1 mV/°C	1.0	5.0 Ω
C5V6	5.3	5.6	6.0 V	+1.0 mV/°C	0.7	4.0 Ω
C6V2	5.8	6.2	6.6 V	+2.0 mV/°C	0.6	3.0 Ω
C6V8	6.4	6.8	7.2 V	+3.0 mV/°C	0.6	3.0 Ω
	at I_Z = 50 mA			at I_Z = 50 mA	at I_Z = 50 mA	
	min.	nom.	max.	typ.	typ.	max.
C7V5	7.1	7.5	7.9 V	+4.0 mV/°C	1.0	3.5 Ω
C8V2	7.7	8.2	8.7 V	+5.0 mV/°C	1.2	3.5 Ω
C9V1	8.6	9.1	9.6 V	+6.4 mV/°C	1.8	4.5 Ω

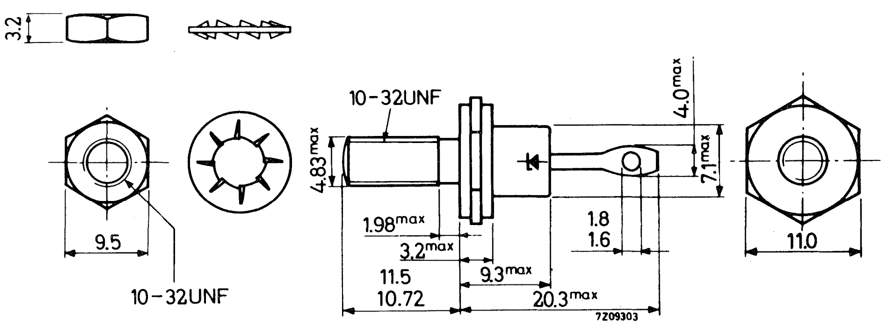
MEDIUM POWER VOLTAGE REGULATORS

Alloyed silicon diodes in a DO-4 metal envelope for use as medium-current voltage stabilisers or voltage references.
Zener voltage range from 5.6 to 24 V with a tolerance of ±5%.

QUICK REFERENCE DATA				
Zener voltage range (tolerance ±5%)		nom.	5.6 to 24	V
Repetitive peak zener current	I_{ZRM}	max.	7	A
Total power dissipation up to T_{mb} = 50 °C	P_{tot}	max.	10	W
Non repetitive peak reverse power dissipation	P_{ZSM}	max.	45	W
Junction temperature	T_j	max.	150	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	10	°C/W

MECHANICAL DATA Dimensions in mm

DO-4



The mark shown applies to normal polarity types

Net weight 4.3 g
With accessories 6.5 g

Mounting torque: min. 8 cm kg
max. 17 cm kg

Diameter of hole in heatsink: max. 5.2 mm
Accessories available for insulated mounting: 56295 (56262A)

RATINGS (Limiting values) [1])

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	0.5	A
Repetitive peak forward current	I_{FRM}	max.	7	A
Repetitive peak zener current	I_{ZRM}	max.	7	A

Power dissipation

Total power dissipation up to T_{mb} = 50 °C	P_{tot}	max.	10	W
Non repetitive peak reverse power ($t < 100\ \mu s$)	P_{ZSM}	max.	45	W

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	$R_{th\ j\text{-}a}$	=	70	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	10	°C/W

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

Forward voltage

I_F = 200 mA	V_F	<	1.0	V

Reverse current

BZZ14	V_R = 2 V	I_R	<	500	nA
BZZ15	V_R = 2 V	I_R	<	500	nA
BZZ16	V_R = 3 V	I_R	<	500	nA
BZZ17	V_R = 3 V	I_R	<	500	nA
BZZ18	V_R = 3 V	I_R	<	400	nA
BZZ19	V_R = 5 V	I_R	<	400	nA
BZZ20	V_R = 5 V	I_R	<	400	nA
BZZ21 to 29	V_R = 5 V	I_R	<	50	nA

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

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

Diode capacitance

BZZ14	V_R = 3 V	C_d	typ.	575	pF
BZZ15	V_R = 3 V	C_d	typ.	475	pF
BZZ16	V_R = 3 V	C_d	typ.	375	pF
BZZ17	V_R = 2 V	C_d	typ.	350	pF
BZZ18	V_R = 2 V	C_d	typ.	300	pF
BZZ19	V_R = 2 V	C_d	typ.	250	pF
BZZ20	V_R = 2 V	C_d	typ.	250	pF
BZZ21	V_R = 3 V	C_d	typ.	340	pF
BZZ22	V_R = 3 V	C_d	typ.	280	pF
BZZ23	V_R = 3 V	C_d	typ.	260	pF
BZZ24	V_R = 3 V	C_d	typ.	240	pF
BZZ25	V_R = 3 V	C_d	typ.	210	pF
BZZ26	V_R = 3 V	C_d	typ.	200	pF
BZZ27	V_R = 3 V	C_d	typ.	155	pF
BZZ28	V_R = 3 V	C_d	typ.	135	pF
BZZ29	V_R = 3 V	C_d	typ.	130	pF

	Zener voltage V_Z (V) at I_Z = 20 mA			Temperature coefficient S_Z (mV/°C) at I_Z = 20 mA			Differential resistance r_Z (Ω) at I_Z = 20 mA	
	min.	nom.	max.	min.	typ.	max.	typ.	max.
BZZ14	5.3	5.6	6.0	−0.4	+0.7	+2.5	4.5	15
BZZ15	5.8	6.2	6.6	+1.0	+2.1	+3.5	2.2	6.0
BZZ16	6.4	6.8	7.2	+2.0	+2.9	+4.0	2.07	5.0
BZZ17	7.1	7.5	7.9	+3.0	+3.75	+4.5	2.3	7.5
BZZ18	7.7	8.2	8.7	+4.0	+4.7	+6.0	2.6	10
BZZ19	8.6	9.1	9.6	+3.5	+5.8	+6.5	3.18	10
BZZ20	9.4	10	10.6	+6.0	+7.0	+8.0	3.8	17
BZZ21	10.4	11	11.6		+7.5		4.4	25
BZZ22	11.4	12	12.6		+8.8		5.25	28
BZZ23	12.4	13	14.1		+10		6.3	33
BZZ24	13.9	15	15.6		+12.6		8.9	39
BZZ25	15.4	16	17.1		+13.8		10.5	48
BZZ26	16.9	18	19.1		+16.4		14.5	54
BZZ27	18.9	20	21.2		+19		19.5	58
BZZ28	20.8	22	23.3		+21.6		26	63
BZZ29	22.7	24	25.9		+24.2		33.5	70

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

	Zener voltage V_Z (V) at I_Z = 100 mA			Temperature coefficient S_Z (mV/°C) at I_Z = 100 mA			Differential resistance r_Z (Ω) at I_Z = 100 mA	
	min.	nom.	max.	min.	typ.	max.	typ.	max.
BZZ14	5.5	5.72	6.3	+0.5	+1.6	+3.0	1.47	4.0
BZZ15	5.8	6.3	6.8	+2.0	+2.45	+4.0	1.12	2.5
BZZ16	6.4	6.9	7.4	+2.5	+3.15	+4.0	1.1	2.5
BZZ17	7.2	7.6	8.2	+3.0	+4.05	+5.0	1.2	3.5
BZZ18	7.8	8.35	9.0	+3.0	+4.9	+6.1	1.38	5.0
BZZ19	8.8	9.3	10	+4.0	+6.1	+7.0	1.65	5.0
BZZ20	9.6	10.3	11	+3.0	+7.25	+11	2.05	5.0
BZZ21		11.3			+9.5		2.0	8.0
BZZ22		12.3			+11		2.5	10
BZZ23		13.4			+12		3.0	13
BZZ24		15.5			+14.8		4.2	16
BZZ25		16.7			+16		5.0	20
BZZ26		18.8			+18.7		7.0	20
BZZ27		21.5			+21.2		9.2	20
BZZ28		23.6			+23.8		12.2	25
BZZ29		26.1			+26.5		16	28

	at I_Z = 500 mA			at I_Z = 500 mA			at I_Z = 500 mA	
	min.	nom.	max.	min.	typ.	max.	typ.	max.
BZZ14	5.5	5.97	6.5	0	+2.15	+3.0	0.54	1.0
BZZ15	6.0	6.6	7.4	+1.5	+2.9	+4.0	0.53	2.0
BZZ16	6.6	7.12	7.9	+2.5	+3.7	+4.0	0.57	2.5
BZZ17	7.1	7.82	8.5	+3.0	+4.6	+7.0	0.62	3.0
BZZ18	8.0	8.57	9.5	+3.5	+5.5	+6.8	0.68	3.0
BZZ19	8.8	9.55	10.2	+4.5	+6.65	+7.5	0.81	3.0
BZZ20	10	10.72	11.6	+3.0	+7.8	+11	0.97	3.0

LOW POWER VOLTAGE REGULATORS

Alloyed silicon diodes in all-glass construction with external metal can for use as low power voltage stabilisers or voltage references. The series consists of eight types with a zener voltage range from 4.7 to 9.1 V with a tolerance of ± 5%

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

Currents

Forward current (d.c. or averaged over any 20 ms period)	I_F	max.	100	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA
Repetitive peak zener current	I_{ZRM}	max.	250	mA
Non repetitive peak zener current ($t \leq 100\ \mu s$)	I_{ZSM}	max.	10	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C with cooling clip 56210 on a heatsink 1.6 mm Al 3.5 cm x 3.5 cm	P_{tot}	max.	500	mW

Temperatures

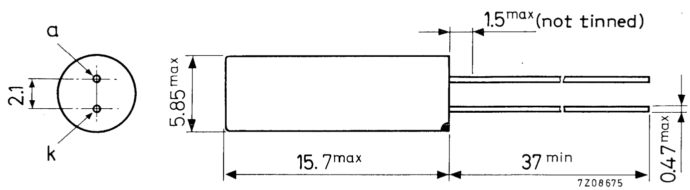
Storage temperature	T_{stg}		-55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j-c}$	=	0.15	°C/mW
From junction to ambient in free air	$R_{th\ j-a}$	=	0.4	°C/mW
From junction to ambient with cooling clip 56209	$R_{th\ j-a}$	=	0.3	°C/mW
From junction to ambient with cooling clip 56210	$R_{th\ j-a}$	=	0.25	°C/mW

MECHANICAL DATA

Dimensions in mm



The coloured dot indicates the cathode

Accessories available: 56200; 56208; 56209; 56210; 56226; 56227

These types have been superseded by BZY88-C4V7 to BZY88-C9V1

CHARACTERISTICS

T_{case} = 25 °C unless otherwise specified

Forward voltage

I_F = 10 mA	V_F	typ. 730	mV
		620 to 820	mV
I_F = 100 mA	V_F	typ. 800	mV
		700 to 920	mV

	Zener voltage V_Z (V)			Temperature coefficient S_Z (mV/°C)			Differential resistance r_Z (Ω)		
	at I_Z = 1 mA			at I_Z = 1 mA			at I_Z = 1 mA		
	min.	nom.	max.	min.	typ.	max.	min.	typ.	max.
OAZ200	4.4	4.7	5.0	−2.75	−2.0	−1.25	320	350	400
OAZ201	4.8	5.1	5.4	−2.5	−1.8	−1.0	270	330	400
OAZ202	5.3	5.6	6.0	−2.5	−1.0	+1.5	50	275	380
OAZ203	5.8	6.2	6.6	−1.0	+0.5	+3.0	10	215	380
OAZ204	6.4	6.8	7.2	0.0	+2.5	+4.0	5.0	40	170
OAZ205	7.1	7.5	7.9	+2.0	+4.0	+5.0	3.0	8.6	35
OAZ206	7.7	8.2	8.7	+2.0	+5.0	+7.0	2.5	7.6	28
OAZ207	8.6	9.1	9.6	+4.0	+6.2	+7.0	2.5	9.6	45
	at I_Z = 5 mA			at I_Z = 5 mA			at I_Z = 5 mA		
	min.	nom.	max.	min.	typ.	max.	min.	typ.	max.
OAZ200	4.9	5.2	5.6	−1.75	−1.2	0.0	30	56	70
OAZ201	5.2	5.6	6.0	−1.5	−0.6	+1.0	12	45	75
OAZ202	5.6	6.0	6.3	−1.0	+0.8	+2.5	5.0	24	55
OAZ203	6.1	6.3	6.8	+0.5	+1.7	+3.5	2.5	9.5	25
OAZ204	6.4	6.9	7.3	+2.0	+3.0	+4.0	2.0	4.7	24
OAZ205	7.1	7.6	8.0	+2.0	+4.3	+5.0	1.0	3.7	17
OAZ206	7.7	8.2	8.8	+2.0	+5.2	+7.5	1.0	3.8	15
OAZ207	8.6	9.2	9.8	+4.0	+6.4	+7.0	1.5	4.9	25
	at I_Z = 20 mA			at I_Z = 20 mA			at I_Z = 20 mA		
	min.	nom.	max.	min.	typ.	max.	min.	typ.	max.
OAZ200	5.3	5.6	5.9	−1.5	+0.2	+1.5	3.0	9.0	15
OAZ201	5.6	5.9	6.2	−0.5	+1.0	+2.5	1.0	5.7	13
OAZ202	5.9	6.2	6.6	+0.5	+1.9	+3.5	1.0	3.2	6
OAZ203	6.1	6.4	6.9	+1.0	+2.6	+4.0	1.0	2.3	11
OAZ204	6.5	7.0	7.4	+2.0	+3.6	+5.0	0.5	2.0	8
OAZ205	7.1	7.7	8.2	+2.0	+4.6	+5.5	0.75	2.2	12
OAZ206	7.8	8.4	9.0	+2.0	+5.4	+7.5	1.0	2.4	10
OAZ207	8.8	9.4	10.0	+4.0	+6.6	+8.0	0.75	2.9	20

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

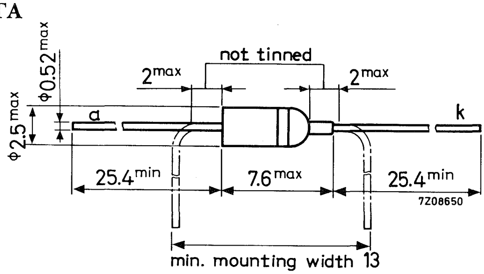
	Diode capacitance at V_R = 3 V			Reverse current		
	min.	typ.	max.	at V_R =	typ.	max.
OAZ200	200	420	650 pF	2 V	0.12	0.50 μA
OAZ201	100	400	650 pF	2 V	0.04	0.50 μA
OAZ202	100	360	600 pF	2 V	0.02	0.30 μA
OAZ203	100	300	500 pF	2 V	0.04	0.30 μA
OAZ204	100	300	450 pF	3 V	0.02	0.25 μA
OAZ205	100	250	400 pF	3 V	0.005	0.20 μA
OAZ206	50	220	350 pF	5 V	0.02	0.20 μA
OAZ207	50	170	300 pF	5 V	0.015	0.15 μA

VOLTAGE REGULATOR DIODES

Silicon alloyed diodes in subminiature all glass DO-7 envelope for use as low power voltage stabilisers or voltage references.
The series consists of 12 types with nominal zener voltages ranging from 3.9 to 12 V with a tolerance of ±5%.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Currents

Repetitive peak zener current	I_{ZRM}	max.	250	mA
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	250	mA

Power dissipation

Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	400	mW

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.31	°C/mW

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Forward voltage at I_F = 10 mA V_F < 900 mV

	Zener voltage [1] at I_Z = 20 mA			Temperature coefficient [1] at I_Z = 20 mA	Differential resistance [1] at I_Z = 20 mA	Reverse current at V_R = 1.0 V T_{amb} =	
	min.	nom.	max.	typ.	max.	25 °C	150 °C
1N748A	3.705	3.9	4.095 V	−1.90 mV/°C	23 Ω	10	30 μA
1N749A	4.085	4.3	4.515 V	−1.55 mV/°C	22 Ω	2.0	30 μA
1N750A	4.465	4.7	4.935 V	−0.845 mV/°C	19 Ω	2.0	30 μA
1N751A	4.845	5.1	5.355 V	−0.405 mV/°C	17 Ω	1.0	20 μA
1N752A	5.320	5.6	5.880 V	+0.336 mV/°C	11 Ω	1.0	20 μA
1N753A	5.890	6.2	6.510 V	+1.36 mV/°C	7.0 Ω	0.1	20 μA
1N754A	6.460	6.8	7.140 V	+2.38 mV/°C	5.0 Ω	0.1	20 μA
1N755A	7.125	7.5	7.875 V	+3.37 mV/°C	6.0 Ω	0.1	20 μA
1N756A	7.790	8.2	8.610 V	+4.26 mV/°C	8.0 Ω	0.1	20 μA
1N757A	8.645	9.1	9.555 V	+5.10 mV/°C	10 Ω	0.1	20 μA
1N758A	9.500	10.0	10.500 V	+6.0 mV/°C	17 Ω	0.1	20 μA
1N759A	11.400	12.0	12.000 V	+7.2 mV/°C	30 Ω	0.1	20 μA

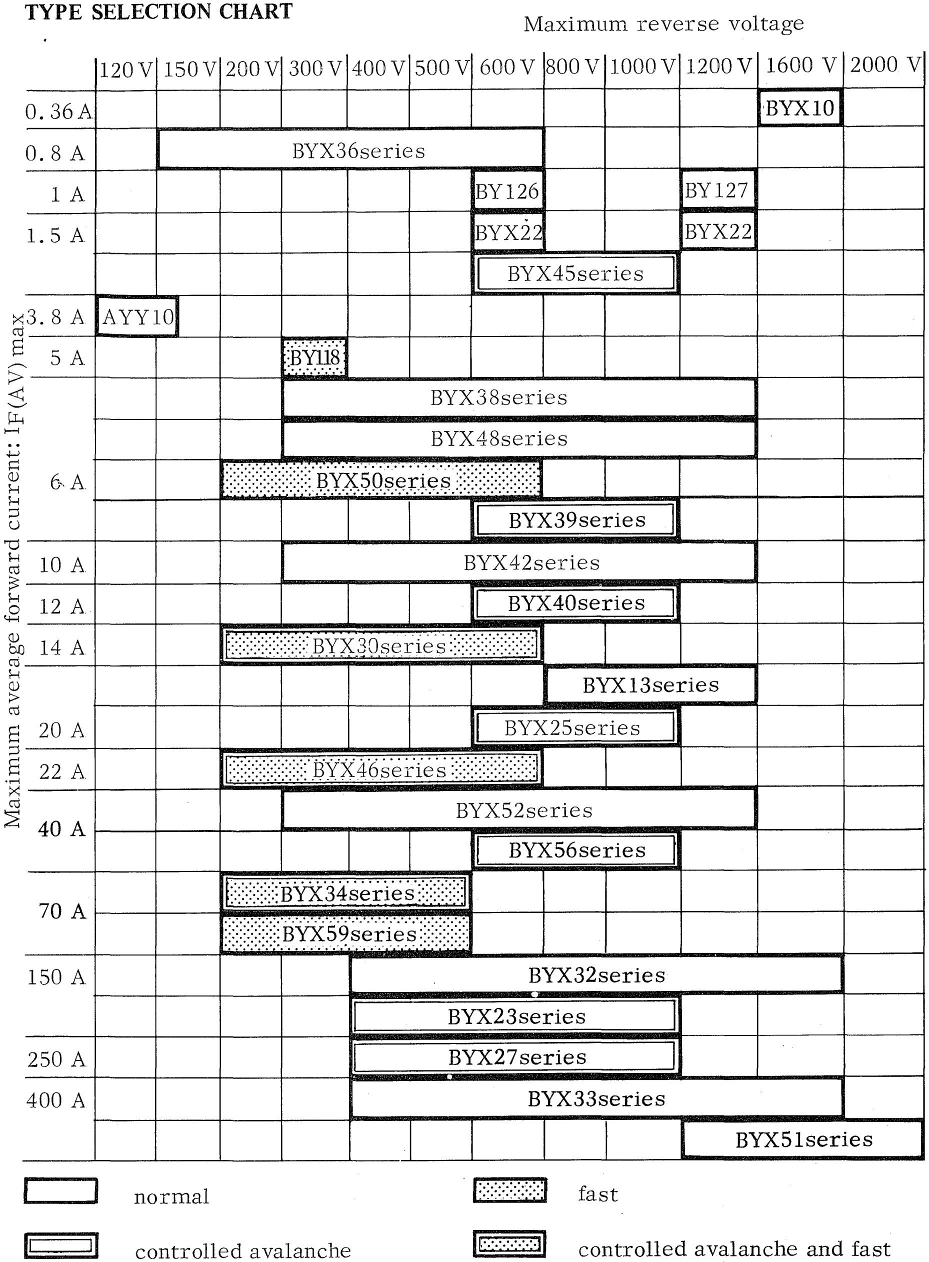
OPERATING NOTES

1. When using a soldering iron, the diodes 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.
2. Diodes may be dip soldered at a solder temperature of 245 °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 5 mm 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.
3. Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

[1]) Measured by a pulse method with $t_p \leq 100\ \mu s$, $\delta = 0.001$, $T_j = 25\ ^{o}C$.

Rectifier diodes

TYPE SELECTION CHART



Maximum reverse voltage

Maximum average forward current: $I_{F(AV)}$ max	1.8 kV	15 kV	37.5 kV	75 kV to 150 kV
2.0 mA	BY184			
2.5 mA		BY176		
50 mA			BYX35	BYX29series

Single phase bridge rectifier assemblies

Maximum imput voltage (r.m.s.)

Average output current I_O	60 V	280 V
1 A		BY179
1.4 A	BY164	

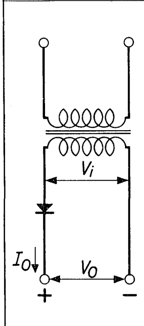
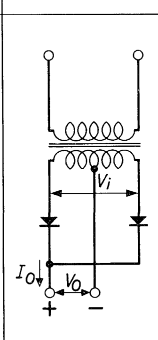
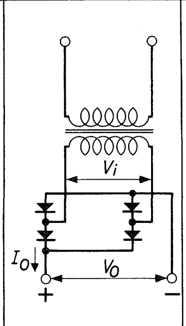
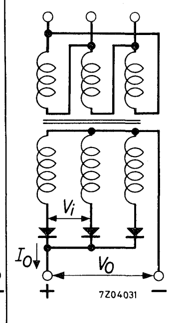
normal

controlled avalanche

fast

OPERATION AS RECTIFIER

Output voltages and currents of diodes in rectifier circuits based on the rated crest working reverse voltage and rated average forward current.

		Single phase half wave	Two phase half wave	Single phase full wave (Single phase bridge)	Three phase half wave (Three phase star)
					
		$I_O = I_{F(AV)}$	$I_O = 2\ I_{F(AV)}$	$I_O = 2\ I_{F(AV)}$	$I_O = 3\ I_{F(AV)}$
V_{RWMmax}	$V_{i(rms)}$	V_O	V_O	V_O	V_O
100	70	30	30	62	47
200	140	60	60	125	95
300	210	90	90	185	140
400	280	125	125	250	190
500	350	155	155	310	235
600	420	185	185	375	280
800	560	250	250	500	380
1000	700	315	315	635	475
1200	840	375	375	750	560
1600	1120	500	500	1000	760

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.

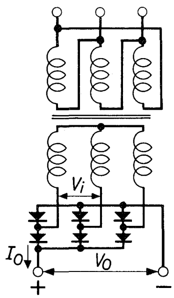
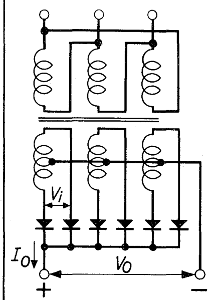
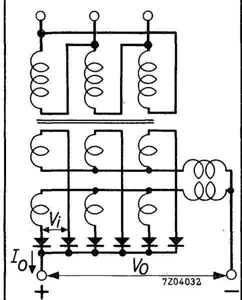
$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_O = average output voltage in V

OPERATION AS RECTIFIER

Output voltages and currents of diodes in rectifier circuits based on the rated crest working reverse voltage and rated average forward current.

		Three phase full wave (Three phase bridge)	Six phase half wave (Six phase star)	Three phase double Y with interphase transformer
				
		$I_O = 3\ I_{F(AV)}$	$I_O = 4.8\ I_{F(AV)}$	$I_O = 6\ I_{F(AV)}$
V_{RWMmax}	$V_{i(rms)}$	V_O	V_O	V_O
100	70	94	47	40
200	140	185	95	80
300	210	280	140	120
400	280	375	190	160
500	350	470	235	200
600	420	565	280	240
800	560	750	380	320
1000	700	940	475	400
1200	840	1120	560	480
1600	1120	1510	760	640

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.

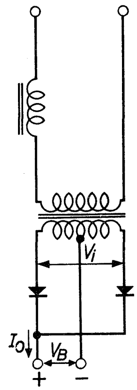
$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

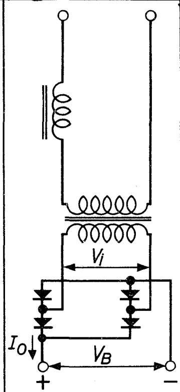
I_O = average output current in A

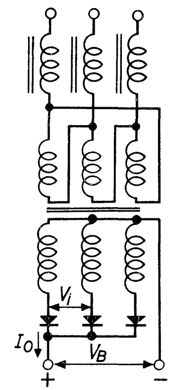
V_O = average output voltage in V

TYPICAL OPERATION FOR BATTERY CHARGING

Output voltages and currents of diodes in rectifier circuits based on the rated crest working reverse voltage and rated average forward current.







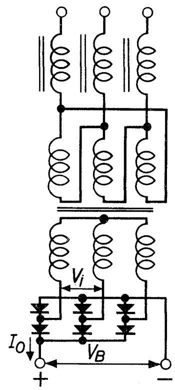
		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
		$I_O = I_{F(AV)}$		$I_O = I_{F(AV)}$		$I_O = 1.5\ I_{F(AV)}$	
V_{RWMmax}	$V_{i(rms)}$	V_O	n	V_O	n	V_O	n
100	62	28	13	60	27	35	16
200	125	60	27	120	54	70	32
300	190	90	41	180	82	105	47
400	255	120	54	240	109	140	64
500	315	150	68	300	136	170	77
600	380	180	82	360	164	210	95
800	510	240	109	480	217	270	122
1000	640	300	136	600	272	340	154
1200	750	360	164	720	328	420	190

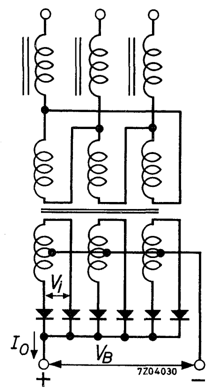
The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = 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)

TYPICAL OPERATION FOR BATTERY CHARGING

Output voltages and currents of diodes in rectifier circuits based on the rated crest working reverse voltage and rated average forward current.





		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)	
		$I_O = 1,5\ I_{F(AV)}$		$I_O = 3\ I_{F(AV)}$	
V_{RWMmax}	$V_{i(rms)}$	V_O	n	V_O	n
100	62	60	27	30	13
200	125	120	54	60	27
300	190	180	82	90	41
400	255	240	109	120	54
500	315	300	136	150	68
600	380	360	164	180	82
800	510	480	217	240	109
1000	640	600	272	300	136
1200	750	720	328	360	164

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)

OPERATING NOTES

When there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage [1]), a damping circuit should be connected across the transformer.
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_{RSM} = the transient voltage peak produced by the transformer
V_{RWM} = the actually applied crest working reverse voltage

The capacitance values calculated from the above table are minimum values; to allow for circuit variations and component tolerances, larger values should be used.

[1]) For controlled avalanche types read: non-repetitive peak reverse power.

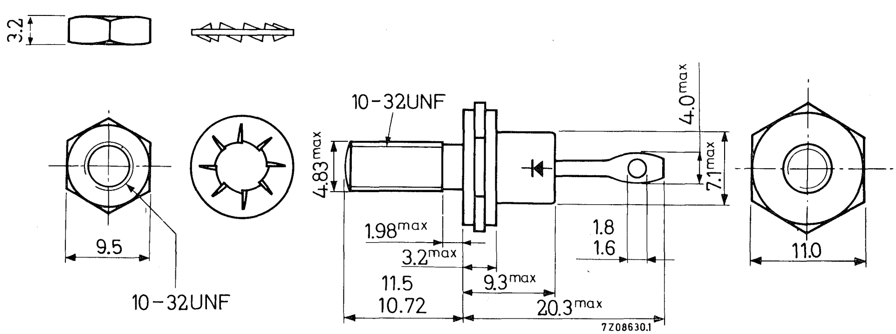
GERMANIUM RECTIFIER DIODE

Germanium diode in a DO-4 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	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	°C/W

MECHANICAL DATA Dimensions in mm

DO-4



Net weight : 4.3 g

With accessories : 6.5 g

Diameter of hole in heatsink : max. 5.2 mm

Accessories available : 56295 (56262A)

Torque on nut: min. 8 cm kg

max. 17 cm kg

All information applies to frequencies up to 1000 Hz

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

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 5)	I_{FSM}	max.	90	A

TEMPERATURES

Storage temperature	T_{stg}		−25 to +75	^{o}C
Junction temperature	T_j	max.	75	^{o}C

THERMAL RESISTANCE

From junction to ambient [1]	$R_{th\ j\text{-}a}$	=	65	$^{o}C/W$
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	1	$^{o}C/W$

CHARACTERISTICS

Voltages

Forward voltage at $I_F = 12$ A; $T_j = 25\ ^{o}C$	V_F	<	0.70	V
$T_j = 75\ ^{o}C$	V_F	<	0.65	V

Currents

Reverse current				
$V_R = 85$ V; $T_j = 25\ ^{o}C$	I_R	<	100	µA
$V_R = 85$ V; $T_j = 75\ ^{o}C$	I_R	<	4	mA

[1]) Length of anode and cathode connectors 40 mm; diam. 1 mm.

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)

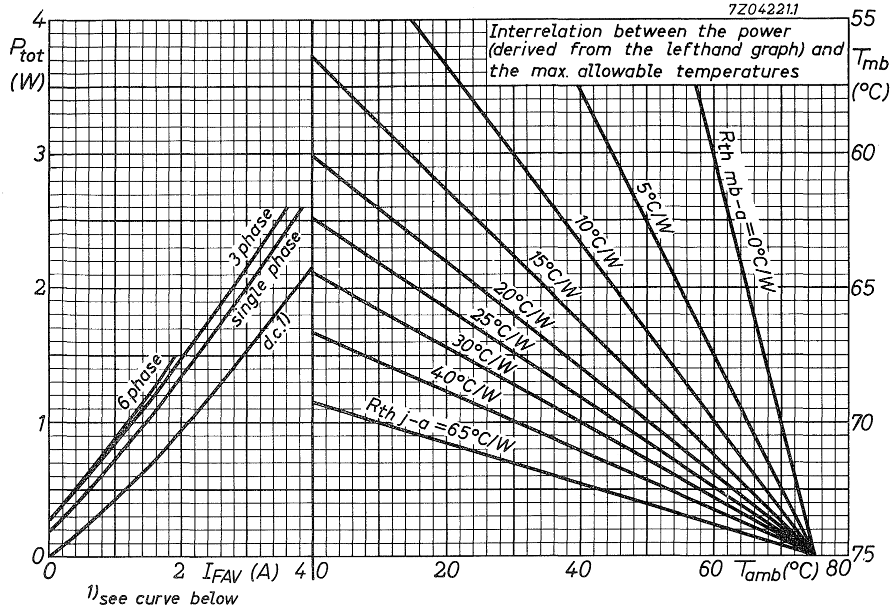
V_2 = transformer secondary r.m.s. voltage (V)

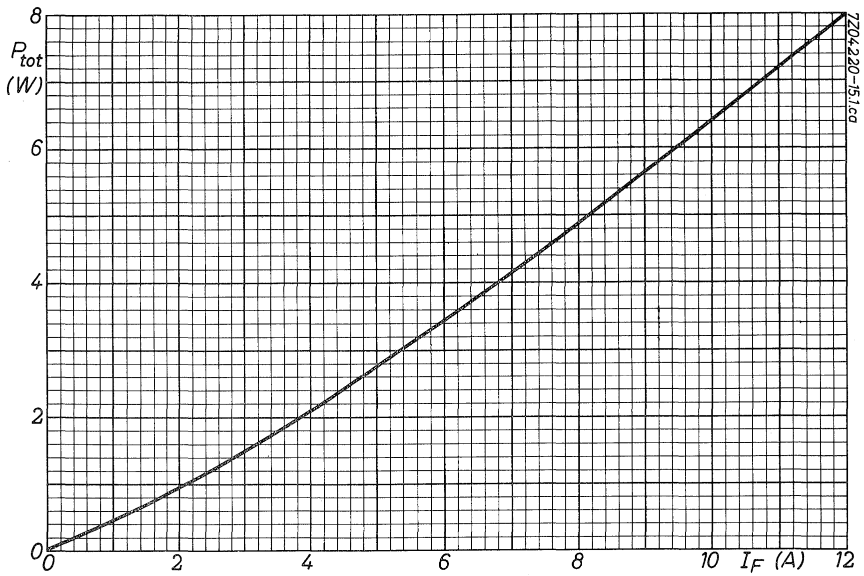
T = V_1/V_2

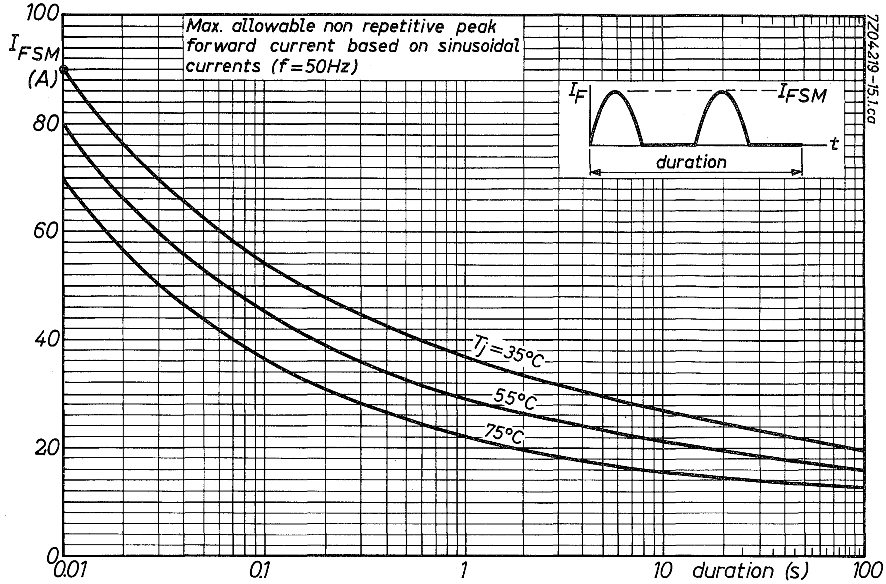
V_{RWM} stands for the actually applied crest working reverse voltage

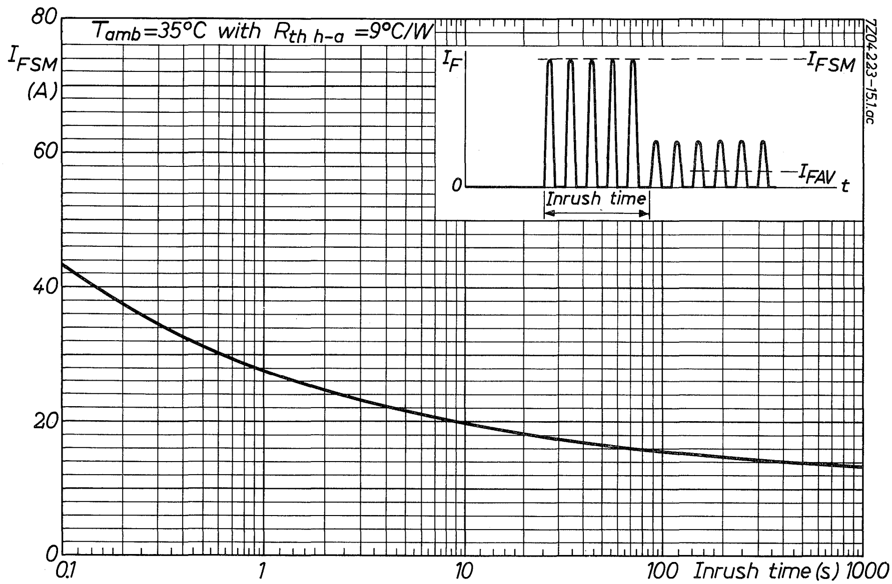
APPLICATION INFORMATION

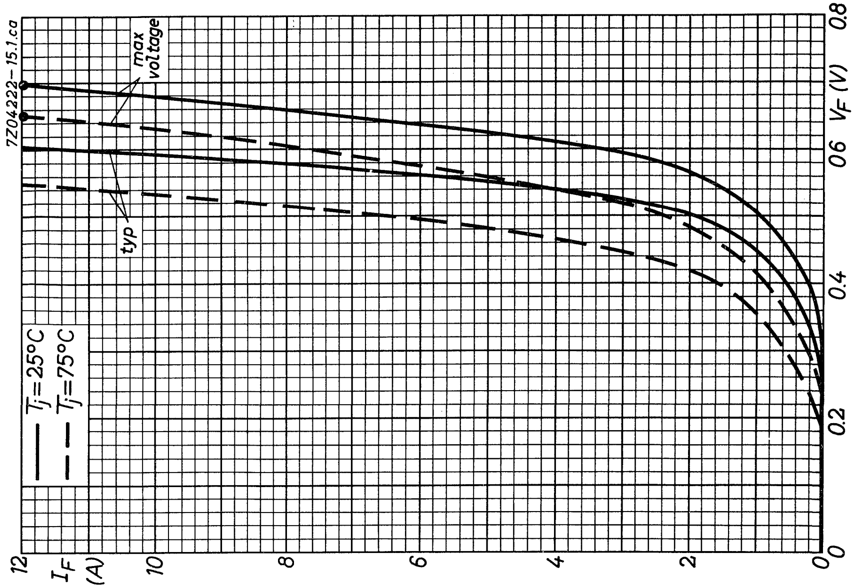
See general pages at the beginning of this section.

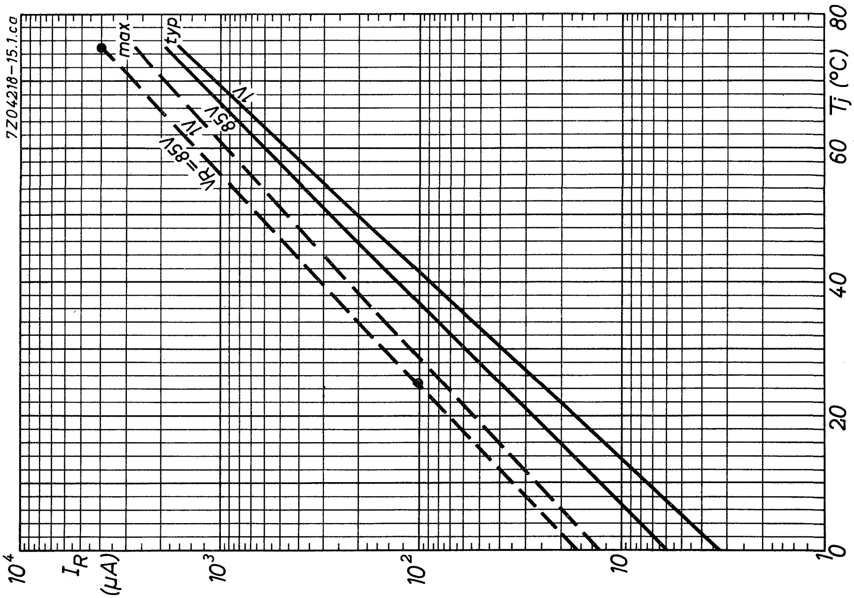

7Z04221.1
Interrelation between the power (derived from the lefthand graph) and the max. allowable temperatures
P_{tot} (W)
T_{mb} (°C)
6 phase
3 phase
single phase
d.c.1)
$R_{th\ mb-a}$ = 0°C/W
5°C/W
10°C/W
15°C/W
20°C/W
25°C/W
30°C/W
40°C/W
$R_{th\ j-a}$ = 65°C/W
I_{FAV} (A)
T_{amb} (°C)
1)see curve below


7Z04220-15.1.ca
P_{tot} (W)
I_F (A)


Max. allowable non repetitive peak forward current based on sinusoidal currents (f=50Hz)
7Z04219-15.1.ca
I_{FSM} (A)
I_F
I_{FSM}
t
duration
T_j=35°C
55°C
75°C
duration (s)
0
20
40
60
80
100
0.01
0.1
1
10
100


T_{amb}=35°C with $R_{th\ h-a}$ =9°C/W
7Z04223-15.1.ac
I_{FSM} (A)
I_F
I_{FSM}
I_{FAV}
t
0
Inrush time
Inrush time (s)
0
20
40
60
80
0.1
1
10
100
1000


7Z04222-15.1.ca
max voltage
typ
Tj=25°C
Tj=75°C
I_F (A)
12
10
8
6
4
2
0
V_F (V)
0
0.2
0.4
0.6
0.8


7Z04218-15.1.ca
max
typ
1V
85V
1V
VR=85V
I_R (μA)
10^4
10^3
10^2
10
1
Tj (°C)
0
20
40
60
80

FAST RECOVERY SILICON DIODE

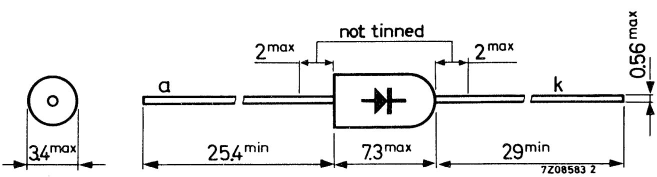
Double diffused general purpose diode in a DO-14 plastic envelope for use as line phase detector, scan rectifier for the supply of the small signal parts in television receivers and other h.f. power supplies.

QUICK REFERENCE DATA

Crest working reverse voltage	V_{RWM}	max.	300	V
Average forward current; V_{RWM} = 300 V	I_{FAV}	max.	0.4	A
V_{RWM} = 80 V	I_{FAV}	max.	0.5	A
Non-repetitive peak forward current half sine wave; t = 10 ms; T_j = 125 °C prior to surge	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	150	°C
Reverse recovery charge when switched from I_F = 10 mA to V_R = 2 V with $-\frac{dI}{dt}$ = 5 mA/µs; T_j = 25 °C	Q_s	<	0.8	nC

MECHANICAL DATA Dimensions in mm

DO-14



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

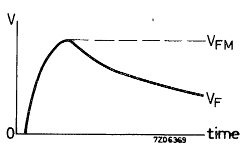
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			
Crest working reverse voltage	V_{RWM}	max.	300 V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	350 V
Non-repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	350 V
Currents			
→ Average forward current (averaged over any 20 ms period) $V_{RWM} = 300$ V	I_{FAV}	max.	0.4 A
$V_{RWM} = 80$ V	I_{FAV}	max.	0.5 A
→ Repetitive peak forward current	I_{FRM}	max.	3.0 A
Non-repetitive peak forward current half sine wave; $t = 10$ ms; $T_j = 125$ °C prior to surge	I_{FSM}	max.	15 A
Repetitive peak reverse current	I_{RRM}	max.	0.5 A
Temperatures			
Storage temperature	T_{stg}	−65 to +125 °C	
→ Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE See page 3

CHARACTERISTICS

Forward voltage at $I_F = 2$ A; $T_j = 150$ °C	V_F	<	1.5 V[1]
Peak reverse current at V_{RM}=300 V; $T_j = 125$ °C	I_{RM}	<	200 µA
Diode capacitance at f = 1 MHz $V_R = 150$ V; $T_j = 25$ to 125 °C	C_d	typ.	4.0 pF
Switching characteristics at $T_j = 25$ °C			
Forward recovery voltage $I_F = 100$ mA; $t_r = 50$ ns	V_{FM}	<	3.0 V



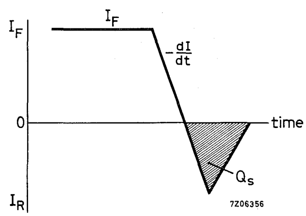
[1]) Measured under pulsed conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Reverse recovery charge when switched from.

I_F = 10 mA to V_R = 2 V with

$-\frac{dI}{dt}$ = 5 mA/µs; T_j = 25 °C $\qquad Q_s < 0.8$ nC

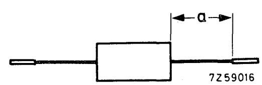


THERMAL RESISTANCE

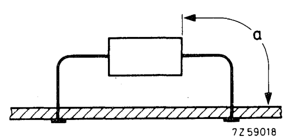
Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 150 °C/W

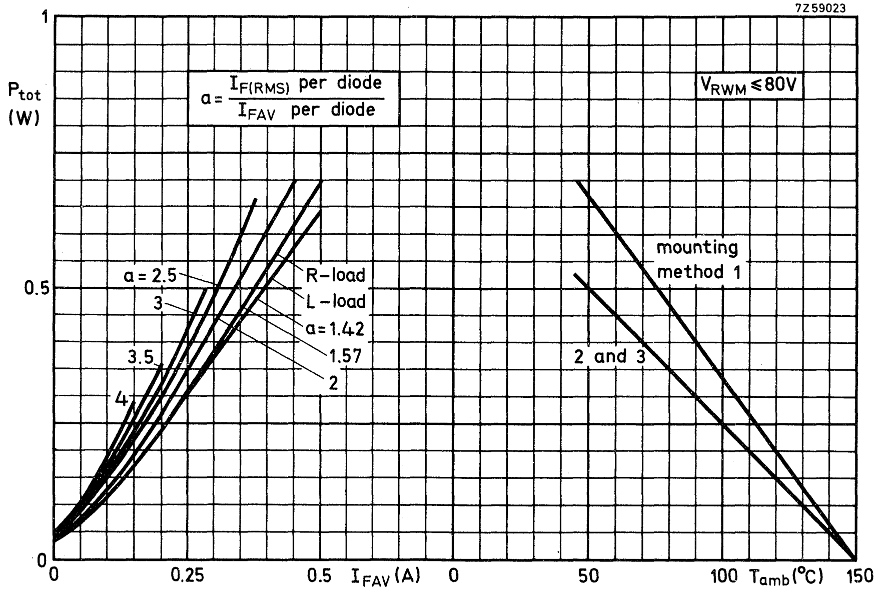


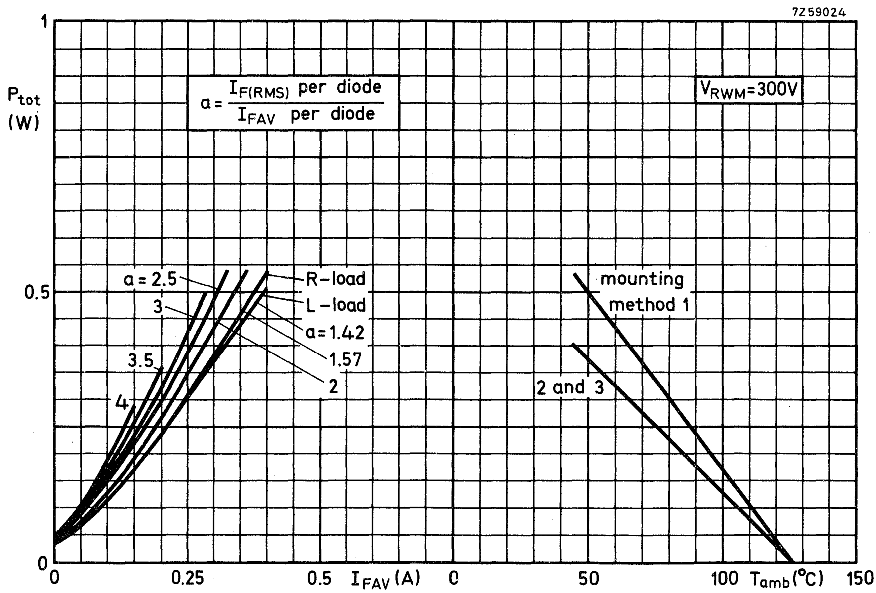
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 200 °C/W
3. Mounted on printed-wiring board with a small area of copper at a lead-length a > 5 mm.
   $R_{th\ j\text{-}a}$ = 200 °C/W



SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125°C.


7Z59023
P_{tot} (W)
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
$V_{RWM} \leq 80V$
a = 2.5
3
3.5
4
R-load
L-load
a = 1.42
1.57
2
mounting method 1
2 and 3
I_{FAV} (A)
T_{amb} (°C)
0
0.25
0.5
0
50
100
150
1
0.5
0

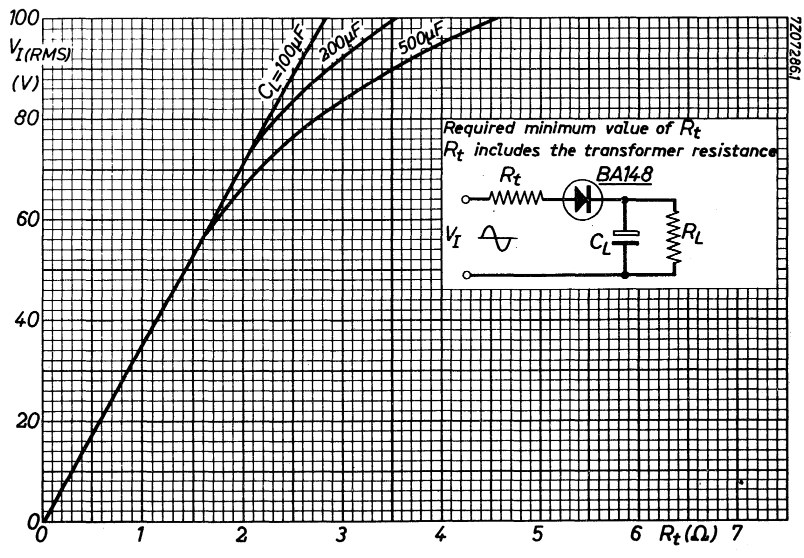

7Z59024
P_{tot} (W)
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
$V_{RWM} = 300V$
a = 2.5
3
3.5
4
R-load
L-load
a = 1.42
1.57
2
mounting method 1
2 and 3
I_{FAV} (A)
T_{amb} (°C)
0
0.25
0.5
0
50
100
150
1
0.5
0

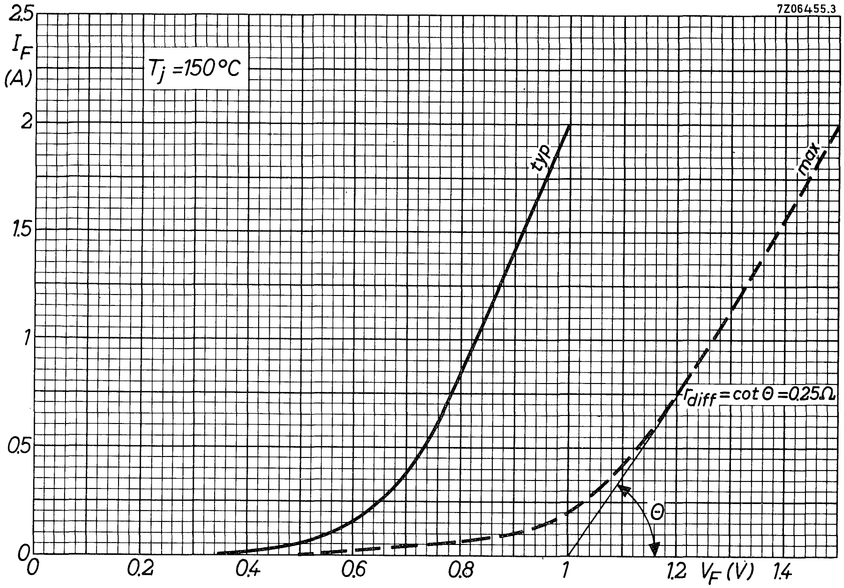
From the left hand graph the total power dissipation can be found as a function of the forward current.

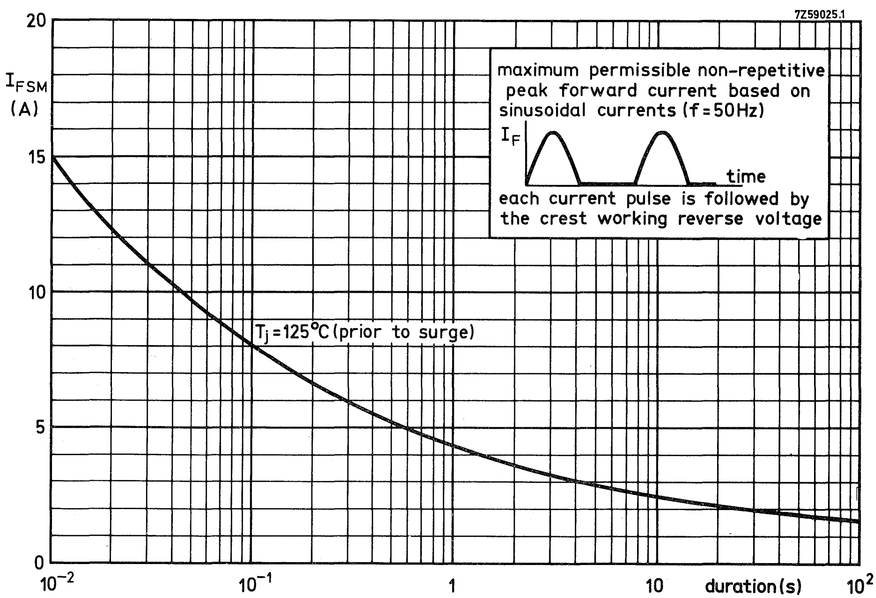
The parameter $a = \dfrac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\dfrac{R_t + r_{diff.}}{R_L}$ and can be found from existing graphs.

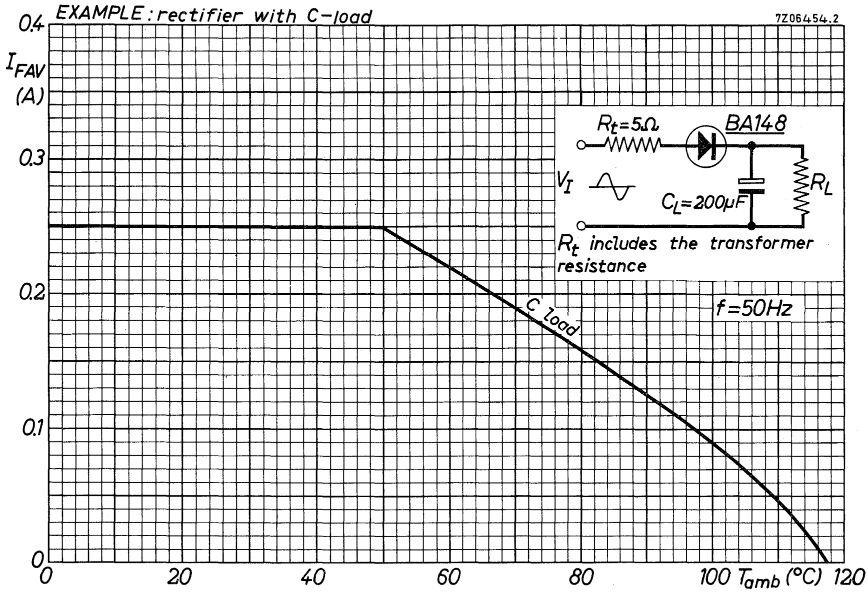
See Application Book: RECTIFIER DIODES
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

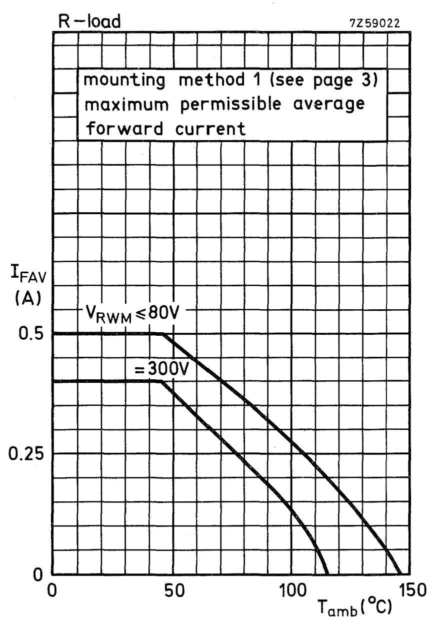
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the graph below.
rdiff. is shown on page 6, upper figure.

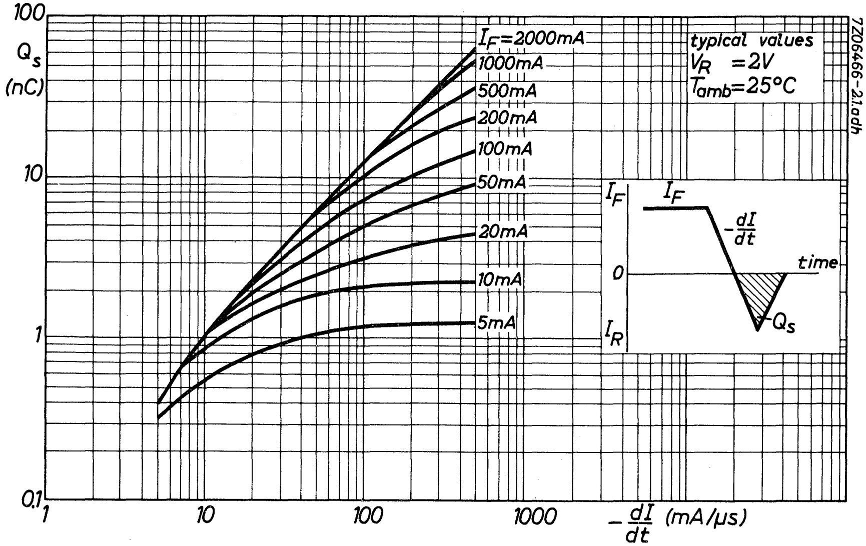


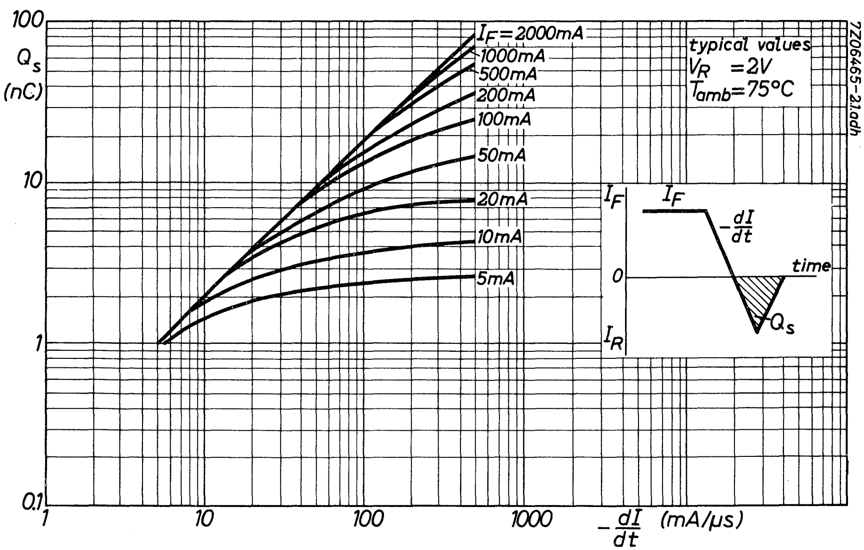

7Z06455.3
I_F (A)
T_j = 150 °C
typ
max
$r_{diff} = \cot\Theta = 0.25\Omega$
Θ
V_F (V)
0 0.2 0.4 0.6 0.8 1 1.2 1.4
0 0.5 1 1.5 2 2.5

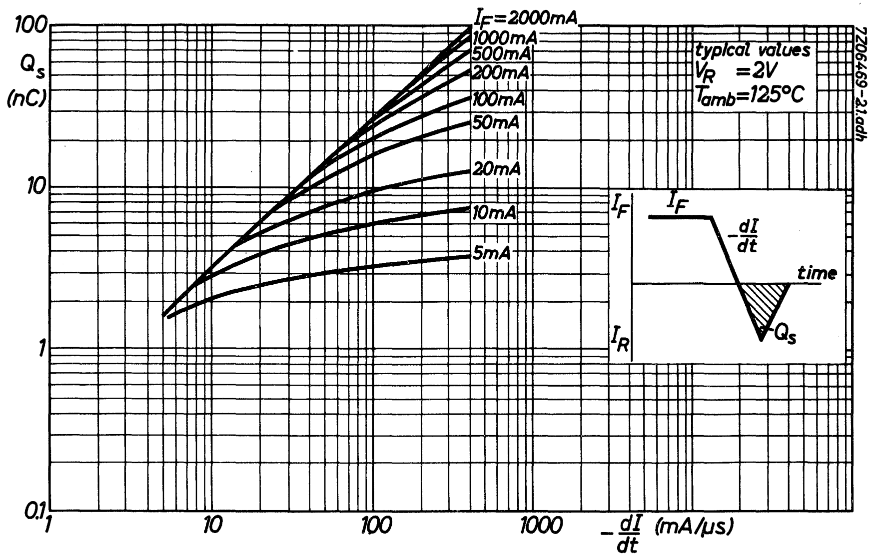

7Z59025.1
I_{FSM} (A)
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 125 °C (prior to surge)
duration (s)
10^{-2} 10^{-1} 1 10 10^2
0 5 10 15 20

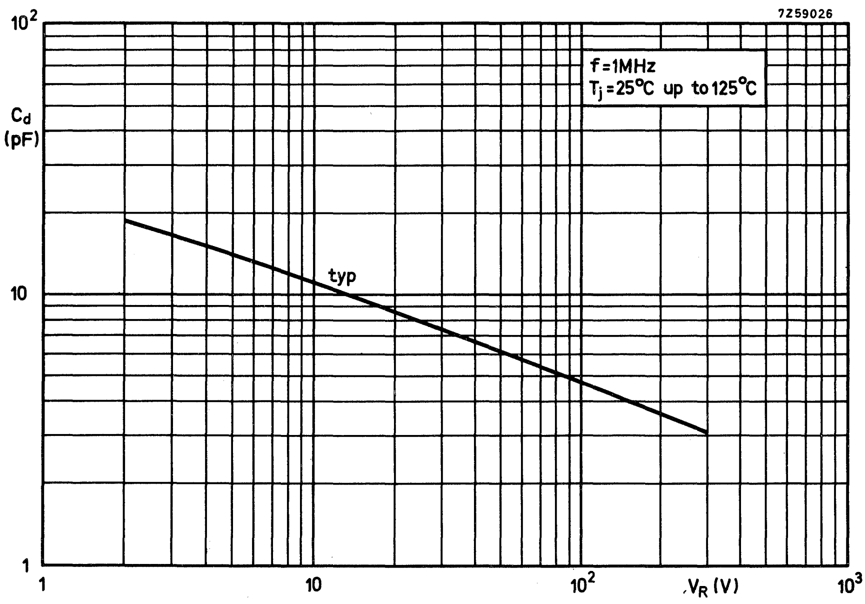

EXAMPLE : rectifier with C-load
7Z06454.2
I_{FAV} (A)
0.4
0.3
0.2
0.1
0
$R_t = 5\Omega$
BA148
V_I
$C_L = 200\mu F$
R_L
R_t includes the transformer resistance
f = 50Hz
C load
0
20
40
60
80
100
T_{amb} (°C)
120


R – load
7Z59022
mounting method 1 (see page 3)
maximum permissible average
forward current
I_{FAV} (A)
0.5
0.25
0
$V_{RWM} \leq 80V$
= 300V
0
50
100
150
T_{amb} (°C)


100
10
1
0.1
Q_s (nC)
1
10
100
1000
$-\frac{dI}{dt}$ (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=25°C
I_F
I_F
$-\frac{dI}{dt}$
0
time
I_R
Q_s
7Z06466-2.1adh

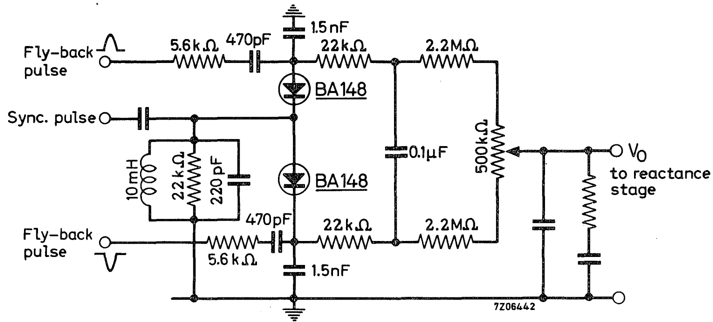

100
10
1
0.1
Q_s (nC)
1
10
100
1000
$-\frac{dI}{dt}$ (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=75°C
I_F
I_F
$-\frac{dI}{dt}$
0
time
I_R
Q_s
7Z06465-2.1adh


100
Q_s
(nC)
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=125°C
7Z06469-2.1.adh
I_F
I_F
$-\frac{dI}{dt}$
time
Q_s
I_R


7Z59026
10^2
C_d
(pF)
10
1
1
10
10^2
V_R (V)
10^3
f=1MHz
T_j=25°C up to 125°C
typ

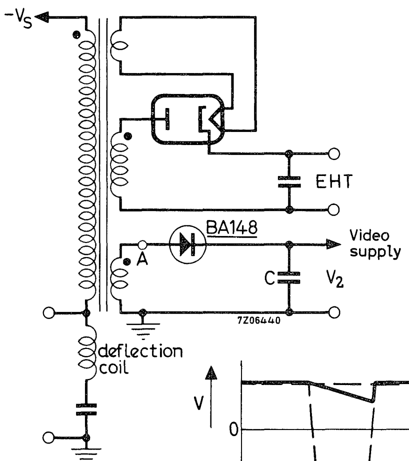
APPLICATION INFORMATION

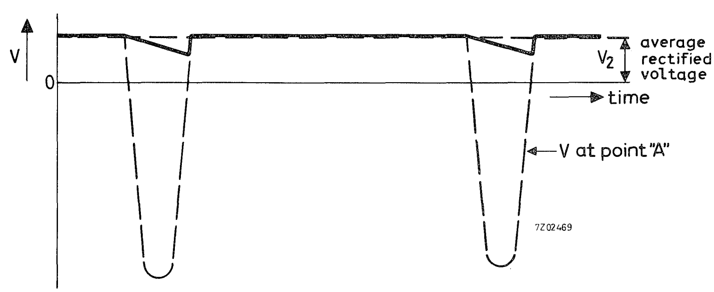
Self catching line phase detector



The high speed and low leakage current of the BA148 make it particularly useful in the type of line phase detector shown above.

Low voltage supply from the line output stage of a television receiver.





An extra winding on the line output transformer in series with a BA148 can supply up to 30 V for the low voltage parts of a television receiver. Because the diode conducts during scan the source impedance is low and the output voltage stable.

SILICON DIODE

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

RATINGS (Limiting values) [1])

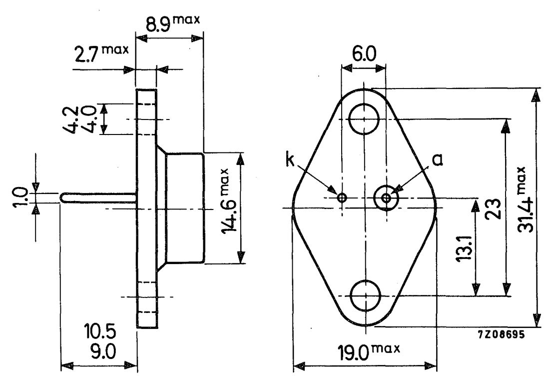
Voltage				
Repetitive peak reverse voltage	V_{RRM}	max.	300	V
Currents				
Forward current (d.c.)	I_F	max.	6	A
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	5	A
Repetitive peak forward current	I_{FRM}	max.	14	A
Repetitive peak forward current (t = 3 μs)	I_{FRM}	max.	20	A
Temperatures				
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

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

MECHANICAL DATA Dimensions in mm

Cathode is connected to mounting base

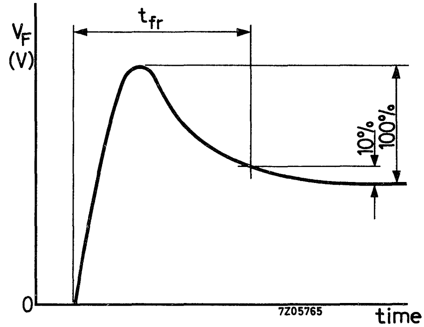


Accessories available: 56203

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

CHARACTERISTICS T_j = 25 °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
Forward recovery time		
I_F = 14 A; t_r = 0.25 μs T_j up to 150 °C	t_{fr}	< 1.0 μs

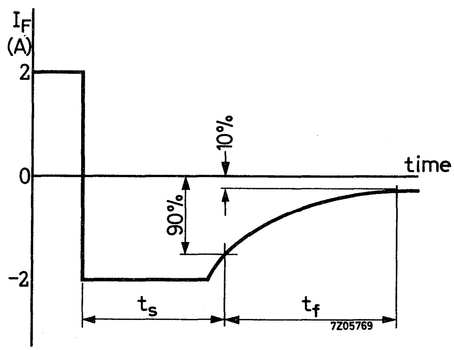


Forward output wave form

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 ; T_j up to 150 °C

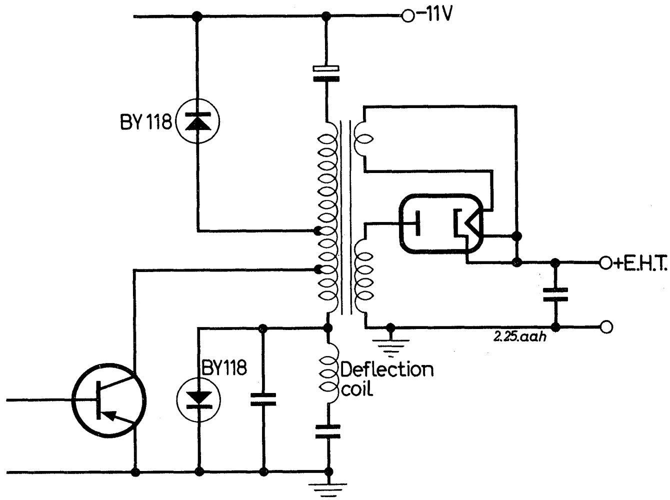
Storage time	t_s	< 3 μs
Fall time	t_f	< 1 μs

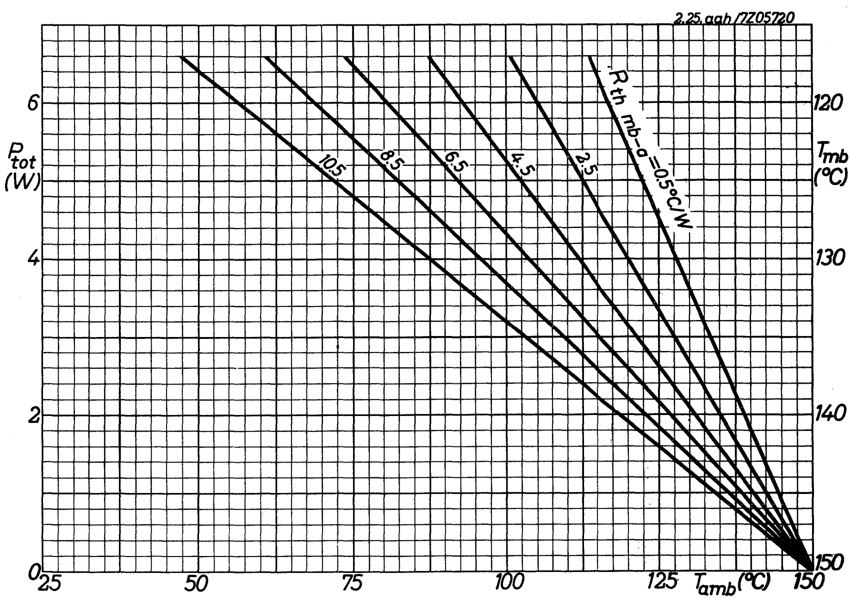


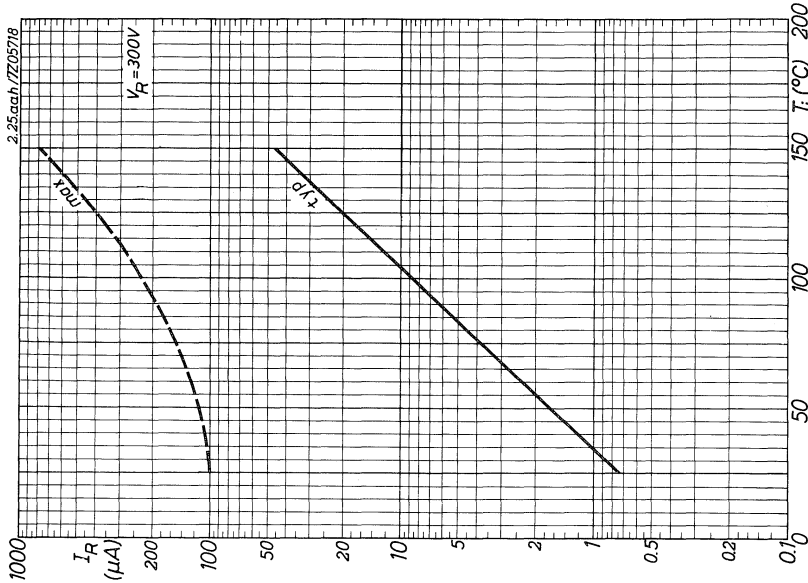
Reverse output wave form

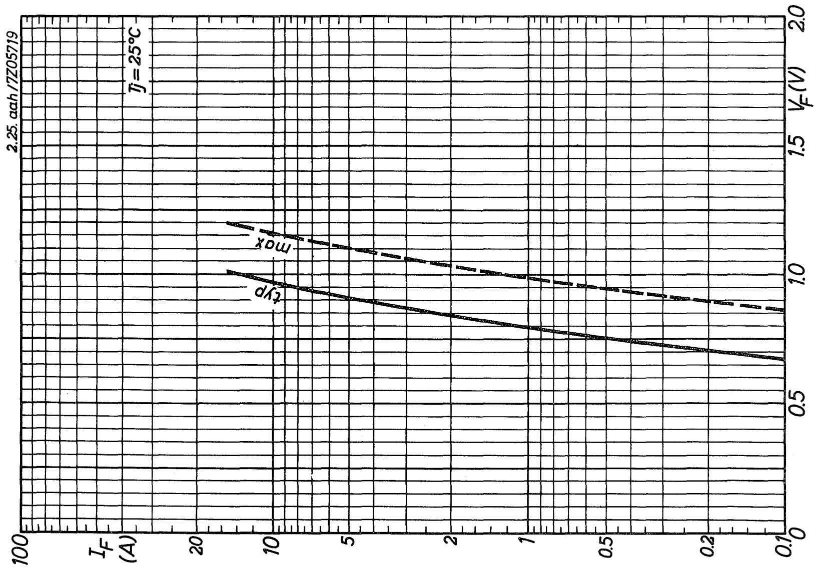
APPLICATION INFORMATION

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






2.25.aah/7Z05718
VR=300V
max
typ
Tj (°C)
IR (μA)


2.25. aah/7Z05719
Tj=25°C
max
typ
VF(V)
IF (A)

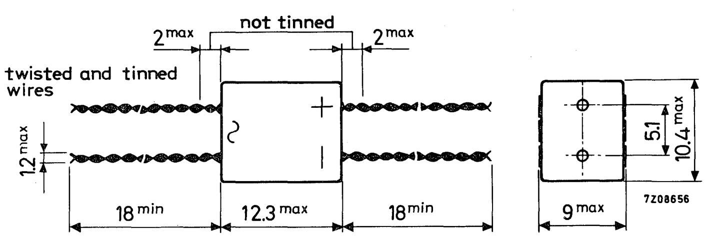
BRIDGE RECTIFIER ASSEMBLY

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				
Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	42	V
Repetitive peak voltage	V_{IRM}	max.	120	V
Output				
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} = 45 °C	I_O	max.	0.8	A
Repetitive peak current	I_{ORM}	max.	3	A
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	50	°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)

All information applies to mains frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (I.E.C. 134)

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
Non repetitive peak current	I_{ISM}	max.	15	A

Output

Average current with C load	See pages 4 and 6			
Average current with R and L load up to T_{amb} = 45 °C	I_O	max.	0.8	A
Repetitive peak current	I_{ORM}	max.	3	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	$R_{th\ j\text{-}a}$	=	50	°C/W

FOR NEW DESIGN THE SUCCESSOR TYPE BY164 IS RECOMMENDED

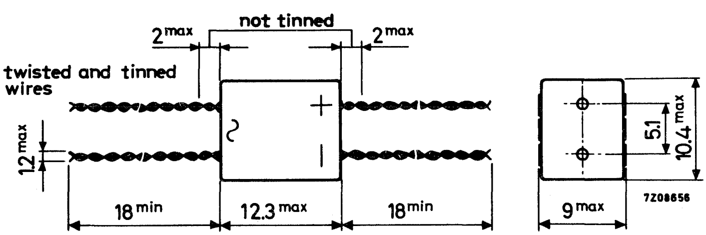
BRIDGE RECTIFIER ASSEMBLY

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				
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.	0.7	A
Repetitive peak current	I_{ORM}	max.	3	A
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	50	°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)

All information applies to mains frequencies up to 400 Hz.

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

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
Non repetitive peak current	I_{ISM}	max.	15	A

Output

Average current with C load	See pages 4 and 6			
Average current with R and L load up to T_{amb} = 40 °C	I_O	max.	0.7	A
Repetitive peak current	I_{ORM}	max.	3	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	$R_{th\ j\text{-}a}$	=	50	°C/W

FOR NEW DESIGN THE SUCCESSOR TYPE BY179 IS RECOMMENDED

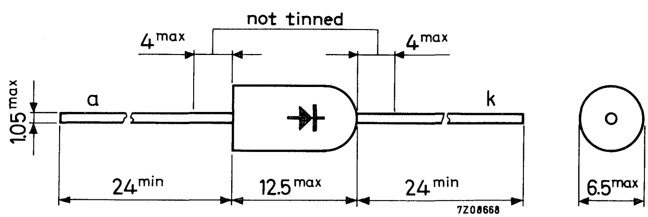
SILICON RECTIFIER DIODES

Silicon double diffused rectifier diodes in a plastic envelope. They are intended for mains rectifier applications in television receivers.

QUICK REFERENCE DATA

			BY126	BY127	
Crest working reverse voltage	V_{RWM}	max.	450	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	650	1250	V
Average forward current with R and L load; $V_{RWM} = V_{RWMmax}$	I_{FAV}	max.	1.0		A
$V_{RWM} = 60$ V	I_{FAV}	max.	1.2		A
Non repetitive peak forward current $t = 10$ ms	I_{FSM}	max.	40		A
Junction temperature	T_j	max.	150		°C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	60		°C/W

MECHANICAL DATA Dimensions in mm



The rounded end indicates the cathode

The envelope fulfils the accelerated damp heat test described in IEC publication 68-2 (test D, severity IV, 6 cycles).

MOUNTING METHODS see page 3.

All information applies to frequencies up to 400 Hz

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

Voltages			BY126	BY127	
Crest working reverse voltage	V_{RWM}	max.	450	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	650	1250	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	650	1250	V

Currents				
Average forward current (averaged over any 20 ms period), see also pages 4, 6, 7 with R and L load; $V_{RWM} = V_{RWMmax}$	I_{FAV}	max.	1.0	A
$V_{RWM} = 60$ V	I_{FAV}	max.	1.2	A
Repetitive peak forward current	I_{FRM}	max.	10	A
Non repetitive peak forward current $t = 10$ ms; half sine wave	I_{FSM}	max.	40	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 $R_{th\ j\text{-}a}$ See page 3

CHARACTERISTICS at $T_j = 25$ °C

Voltage				
Forward voltage at $I_F = 5$ A	V_F	<	1.5	V

Current				
Reverse current at $V_R = V_{RRMmax}$	I_R	<	10	μA

in

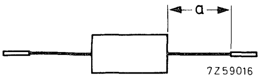
THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

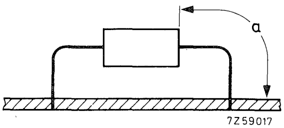
1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 60 °C/W

2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 70 °C/W



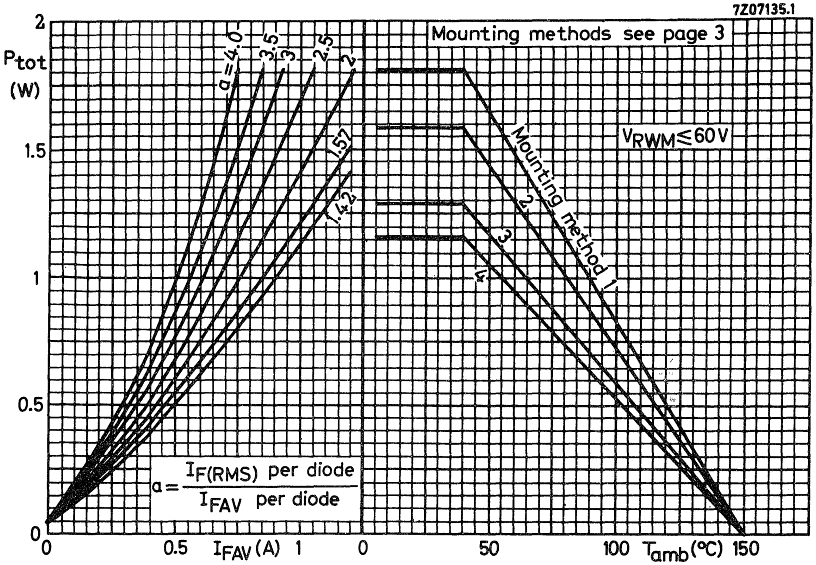
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 85 °C/W

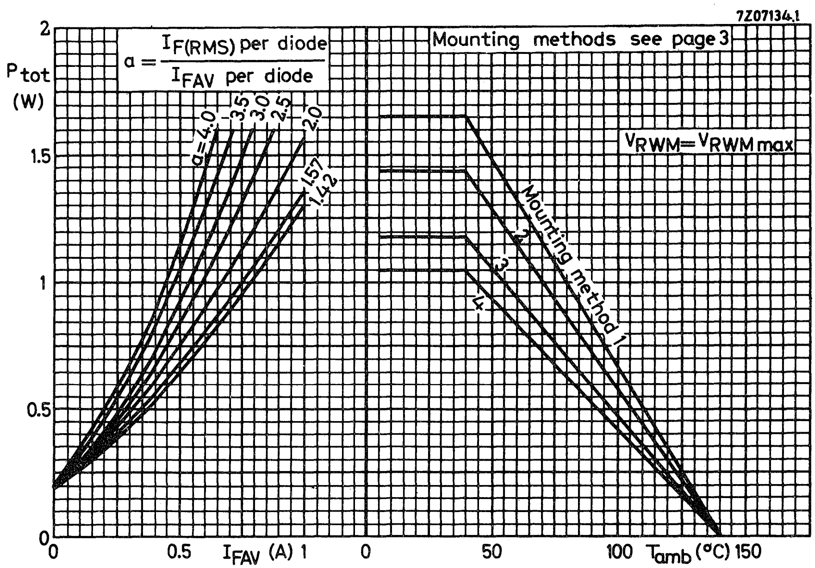
4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 95 °C/W

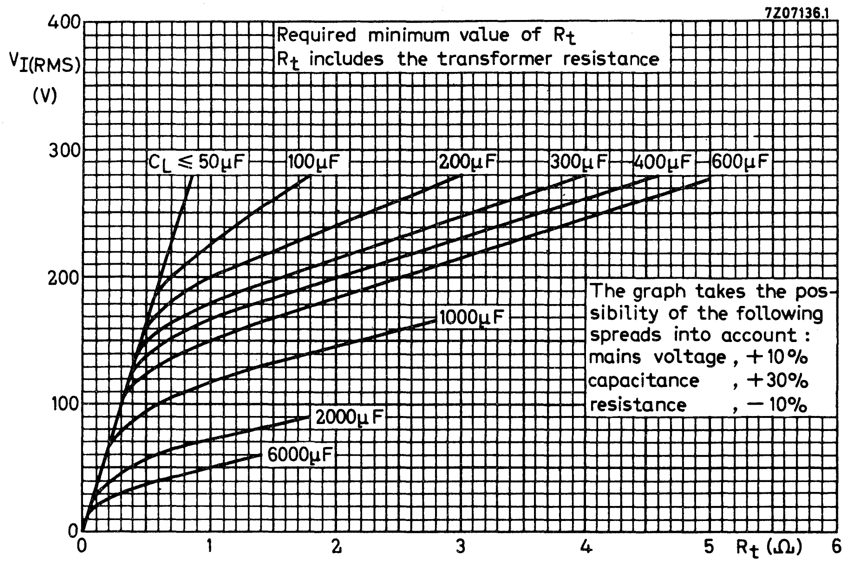


SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.


7Z07135.1
Ptot (W)
2
1.5
1
0.5
0
a=4.0
3.5
3
2.5
2
1.57
1.42
Mounting methods see page 3
VRWM≦60V
Mounting method 1
2
3
4
a = IF(RMS) per diode / IFAV per diode
0
0.5
IFAV (A)
1
0
50
100
Tamb (°C)
150


7Z07134.1
Ptot (W)
2
1.5
1
0.5
0
a = IF(RMS) per diode / IFAV per diode
a=4.0
3.5
3.0
2.5
2.0
1.57
1.42
Mounting methods see page 3
VRWM=VRWMmax
Mounting method 1
2
3
4
0
0.5
IFAV (A)
1
0
50
100
Tamb (°C)
150



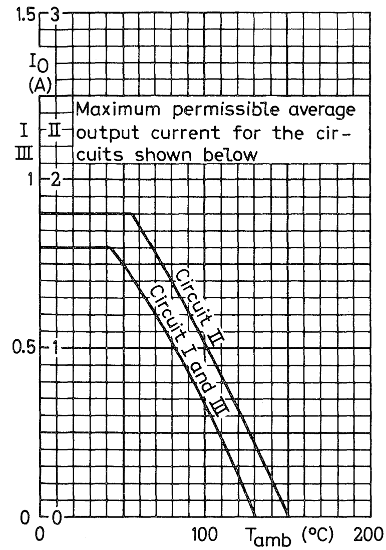
From the left hand graph on page 4 the total power dissipation can be found as a function of the average output current.

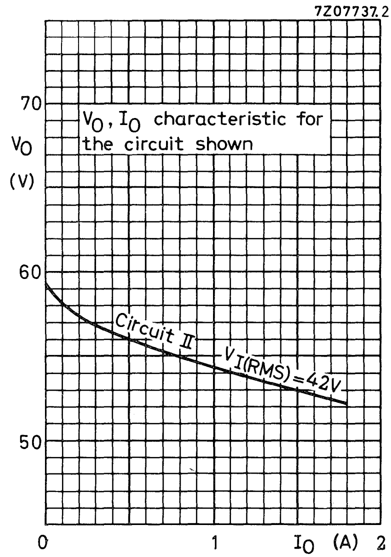
The parameter $a = \dfrac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $n\omega R_L C_L$ and $\dfrac{R_t + R_{diff}}{nR_L}$ and can be found from existing graphs.

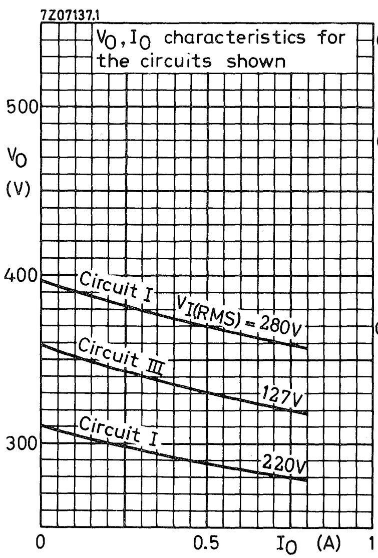
See Application Book: RECTIFIER DIODES
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

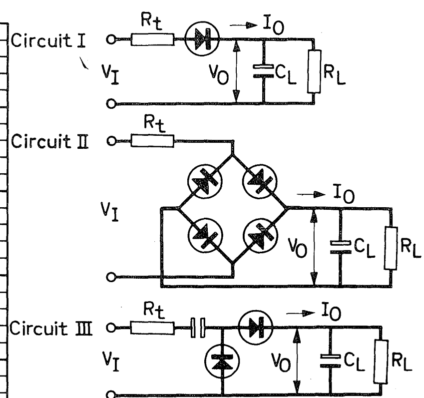
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph.
R_{diff} is shown on page 7.

EXAMPLE: Rectifier with C-load
mounting method 1 (see page 3)

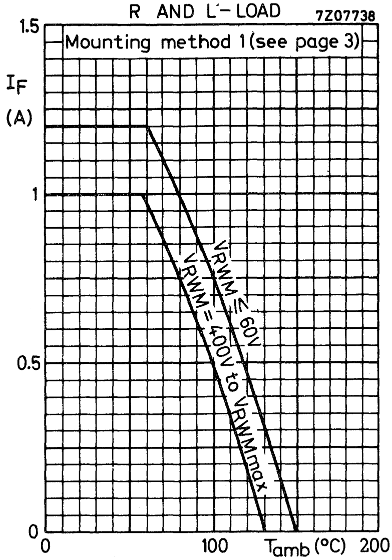


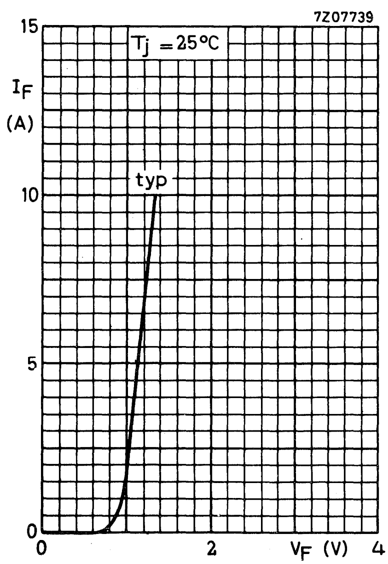


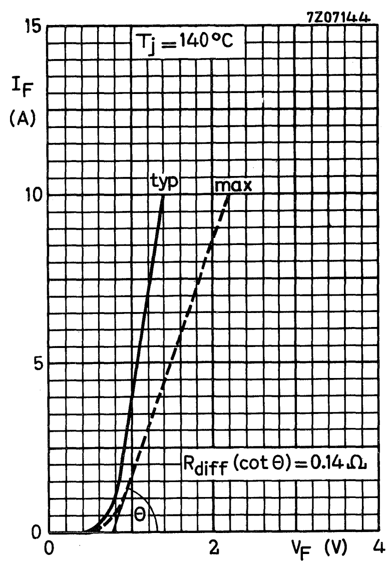


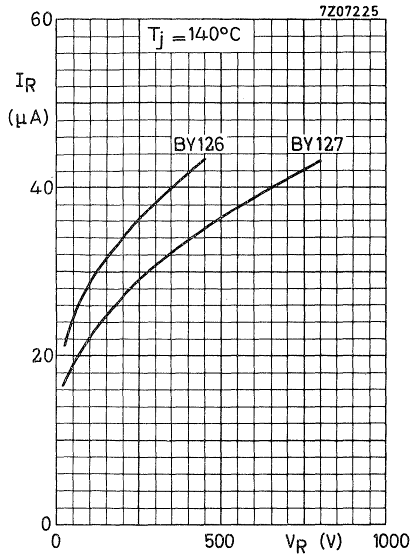


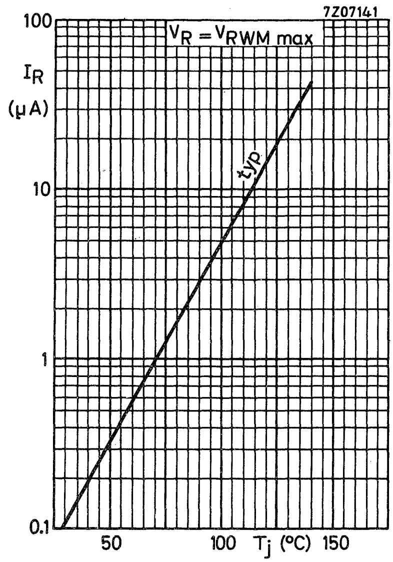
	$V_{I(RMS)}$	R_t	C_L
Circuit I	220V 280V	1.4 Ω 3.0 Ω	200 µF 200 µF
Circuit II	42V	0.72 Ω	6000 µF
Circuit III	127V	0.4 Ω	400 µF

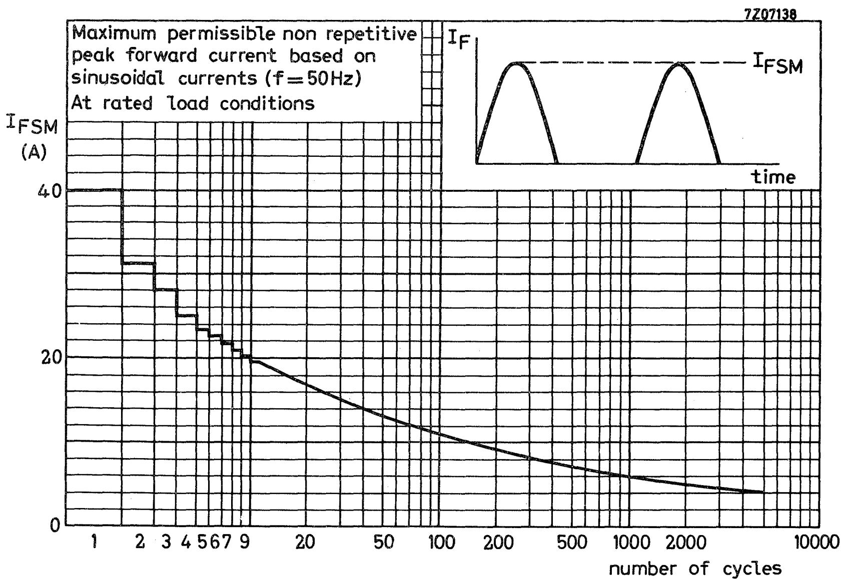

R AND L-LOAD
7Z07738
Mounting method 1 (see page 3)
IF (A)
VRWM ≤ 60V
VRWM = 400V to VRWMmax
Tamb (°C)
0
100
200
0.5
1
1.5


7Z07739
Tj = 25°C
IF (A)
typ
VF (V)
0
2
4
5
10
15


7Z07144
Tj = 140°C
IF (A)
typ
max
Rdiff (cot Θ) = 0.14 Ω
Θ
VF (V)
0
2
4
5
10
15


7Z07225
$T_j = 140°C$
I_R
(µA)
BY126
BY127
60
40
20
0
0
500
V_R (V)
1000


7Z07141
$V_R = V_{RWM\,max}$
I_R
(µA)
typ
100
10
1
0.1
50
100
T_j (°C)
150


7Z07138
Maximum permissible non repetitive
peak forward current based on
sinusoidal currents (f = 50 Hz)
At rated load conditions
I_F
I_{FSM}
time
I_{FSM}
(A)
40
20
0
1
2
3
4
5
6
7
9
20
50
100
200
500
1000
2000
10000
number of cycles

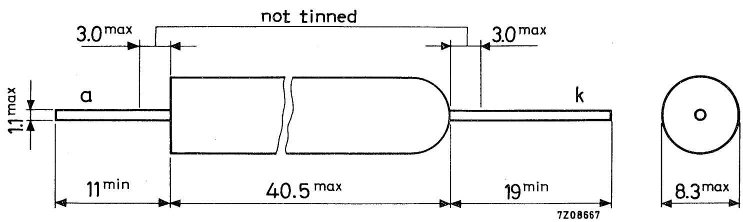
HIGH SPEED HIGH VOLTAGE DIODE

High speed silicon diode in a plastic envelope. It is intended for high voltage rectifier circuits in line deflection circuits in colour and black and white television receivers.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	15	kV
Repetitive peak reverse voltage	V_{RRM}	max.	15	kV
Average forward current	I_{FAV}	max.	2.5	mA
Non repetitive peak forward current	I_{FSM}	max.	1000	mA
Junction temperature	T_j	max.	95	°C
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/μs	Q_s	typ.	30	nC

MECHANICAL DATA

Dimensions in mm



The rounded end indicates the cathode side

- -

FOR NEW DESIGN THE SUCCESSOR TYPE
BY176 IS RECOMMENDED

- -

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

Voltages

Crest working reverse voltage	V_{RWM}	max.	15	kV
Repetitive peak reverse voltage	V_{RRM}	max.	15	kV
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	15	kV

Currents

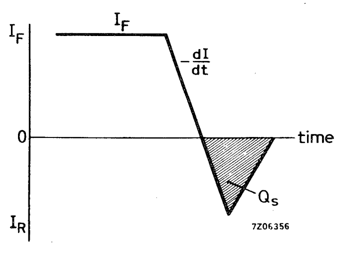
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	2.5	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA
Non repetitive peak forward current ($t \leq 10$ ms)	I_{FSM}	max.	1000	mA
Repetitive peak reverse current during switching off	I_{RRM}	max.	150	mA

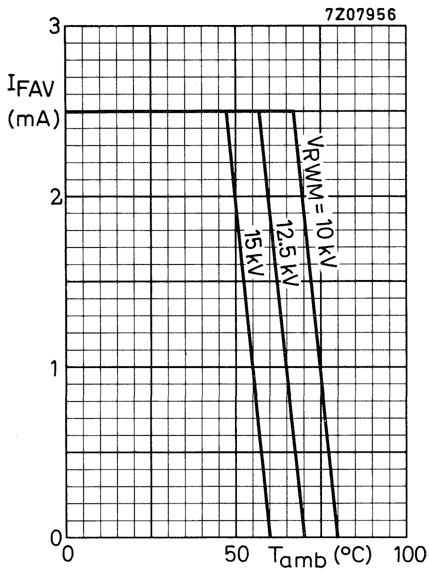
Temperatures

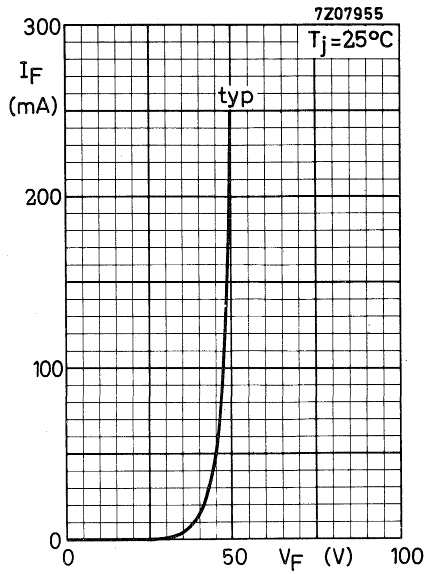
Storage temperature	T_{stg}	−55 to +100		°C
Junction temperature	T_j	max.	95	°C

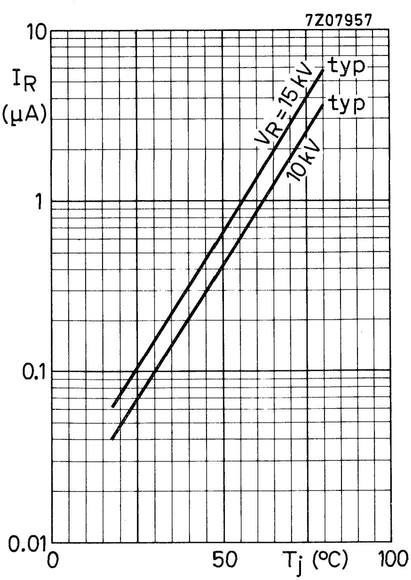
CHARACTERISTICS

Forward voltage at I_F = 100 mA; T_j = 95 °C	V_F	<	50	V
Reverse current at V_R = 15 kV; T_j = 75 °C	I_R	<	10	µA
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/µs; T_j = 25 °C	Q_s	typ.	30	nC




7Z07956
3
2
1
0
I_{FAV}
(mA)
V_{RWM} = 10 kV
12.5 kV
15 kV
0
50
T_{amb} (°C)
100

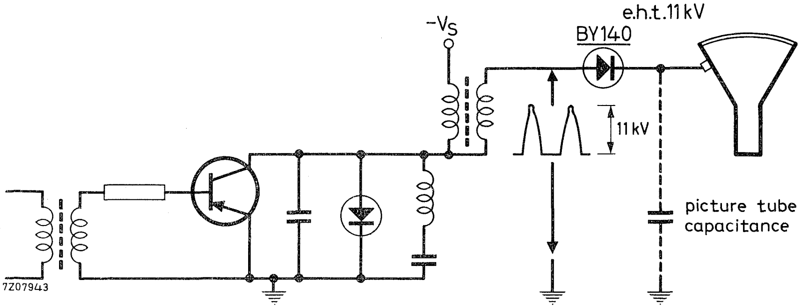

7Z07955
T_j = 25°C
300
200
100
0
I_F
(mA)
typ
0
50
V_F (V)
100


7Z07957
10
1
0.1
0.01
I_R
(µA)
V_R = 15 kV
10 kV
typ
typ
0
50
T_j (°C)
100

APPLICATION INFORMATION

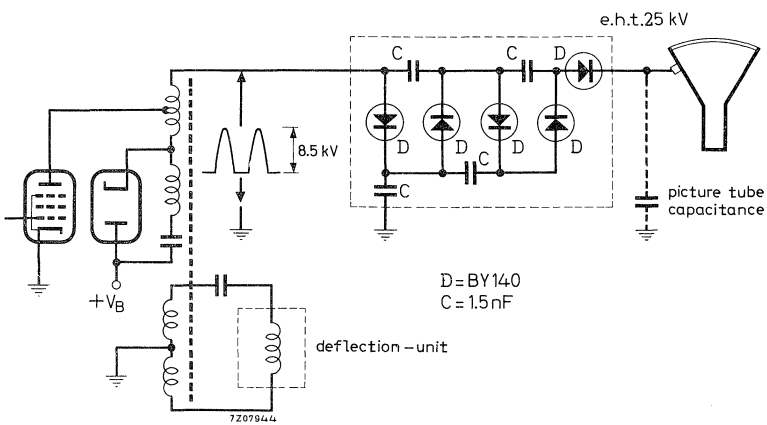
E.H.T. rectifier circuits

A.



Typical deflection circuit for small screen television receivers employing the BY140 as an e.h.t. rectifier. Proper operation of the BY140 is ensured up to an ambient temperature of 60 °C.
The contribution of the BY140 to the overall e.h.t. regulation of the circuit is negligibly small.

B.



E.H.T. supply for colour television receivers by means of a tripler circuit employing BY140 diodes. Proper operation of the BY140 diodes is ensured up to an ambient temperature of 70 °C.
Contribution to the regulation of the complete horizontal deflection output circuit due to the tripler system (inside the dashed-lines): 600 kΩ.

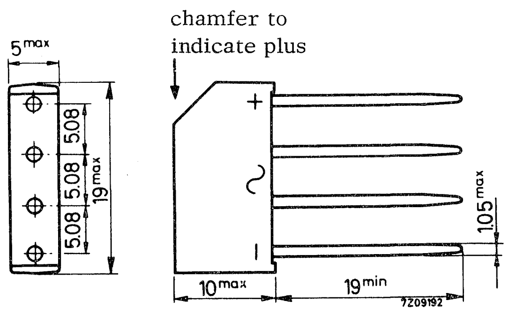
BRIDGE RECTIFIER ASSEMBLY

Plastic encapsulated bridge rectifier assembly comprising four silicon double diffused diodes.
It is primarily intended for use in the power supplies of many types of transistorized equipment operating at frequencies up to 400 Hz.

QUICK REFERENCE DATA				
Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	60	V
Repetitive peak voltage	V_{IRM}	max.	120	V
Output				
Continuous voltage				
with C load	V_O		85	V
with R and L load	V_O		54	V
Average current with				
R and L load; $V_{I(RMS)} \leq 60$ V	I_O	max.	1.2	A
$V_{I(RMS)} \leq 42$ V	I_O	max.	1.4	A
Repetitive peak current	I_{ORM}	max.	5	A

MECHANICAL DATA

Dimensions in mm



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

All information applies to mains frequencies up to 400 Hz.

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

Input

R.M.S. voltage	$V_{I(RMS)}$	max.	60	V
Crest working voltage	V_{IWM}	max.	85	V
Repetitive peak voltage	V_{IRM}	max.	120	V
Non repetitive peak voltage; $t \leq 10$ ms	V_{ISM}	max.	120	V
Non repetitive peak current (see also page 6)	I_{ISM}	max.	25	A

Output

Average current with C load	See pages 3, 4 and 5			
Average current with R and L load (see also page 6)				
$V_{I(RMS)} \leq 60$ V	I_O	max.	1.2	A
$V_{I(RMS)} \leq 42$ V	I_O	max.	1.4	A
Repetitive peak current	I_{ORM}	max.	5	A

Temperatures

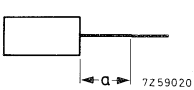
Storage temperature	T_{stg}	−55 to +125		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

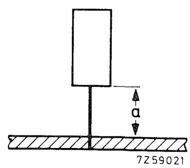
Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a > 5 mm. $R_{th\ j\text{-}a} = 40\ ^oC/W$



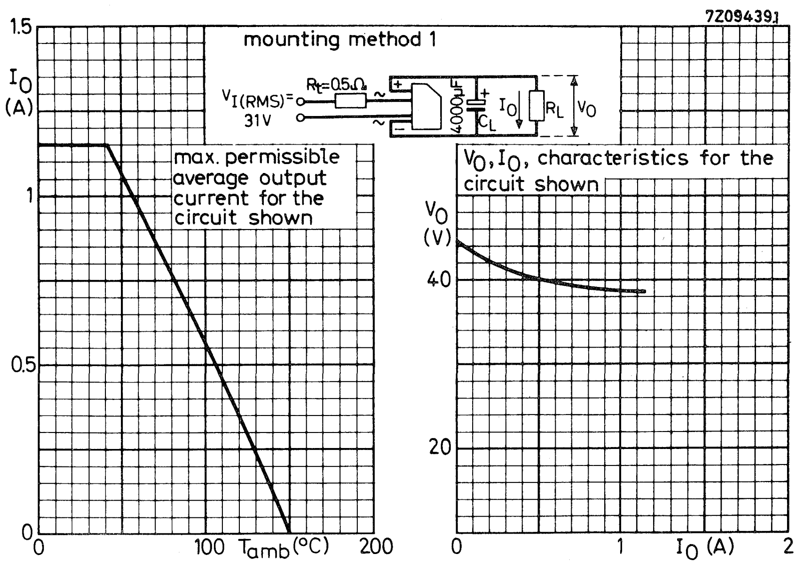
2. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j\text{-}a} = 50\ ^oC/W$
3. Mounted on printed-wiring board at a lead-length a = 5 mm. $R_{th\ j\text{-}a} = 55\ ^oC/W$

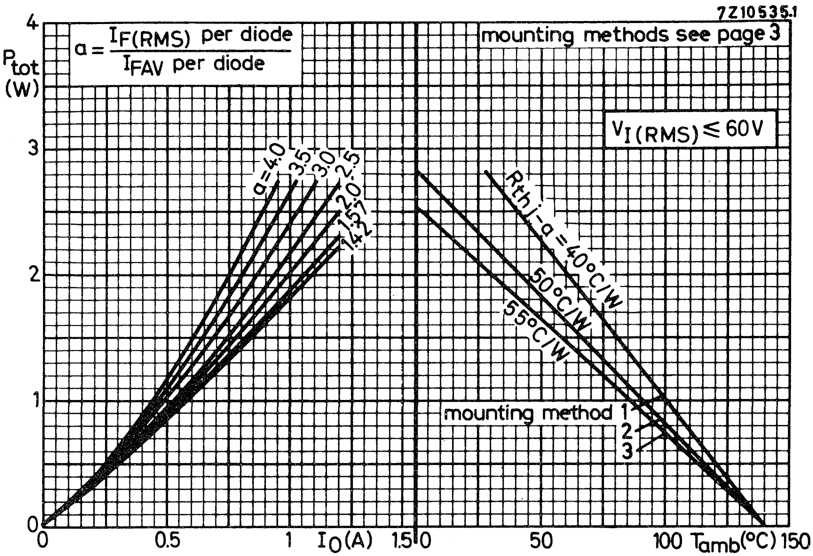


SOLDERING AND MOUNTING NOTES

1. The maximum permissible contact time for the soldering iron or bath is 3 seconds.
2. If the soldered joints are at least 5 mm from the seal, the maximum permissible temperature of the soldering iron or bath is 270 °C. If the joints are between 1.5 mm (min) and 5 mm from the seal, the maximum permissible temperature is 250 °C.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

EXAMPLE: Rectifier with C load





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

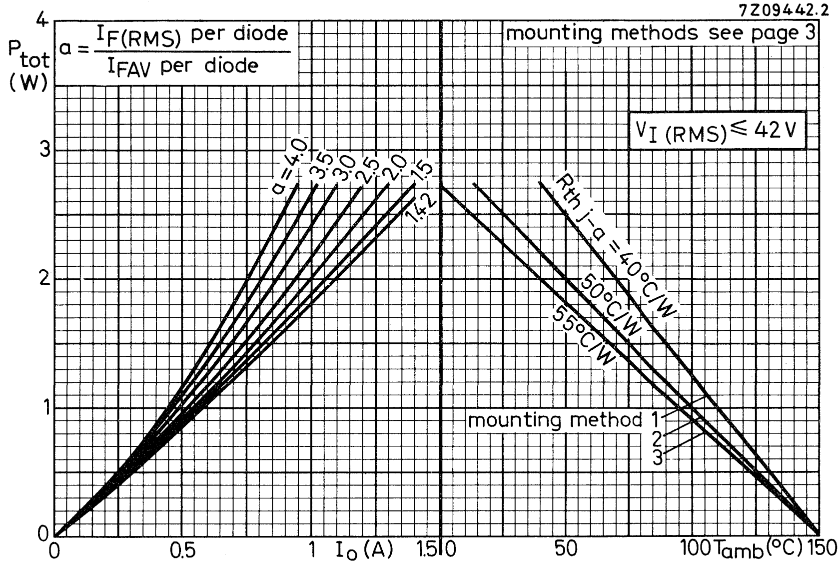
The parameter $a = \dfrac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\dfrac{R_t + R_{diff}}{R_L}$ and can be found from existing graphs.

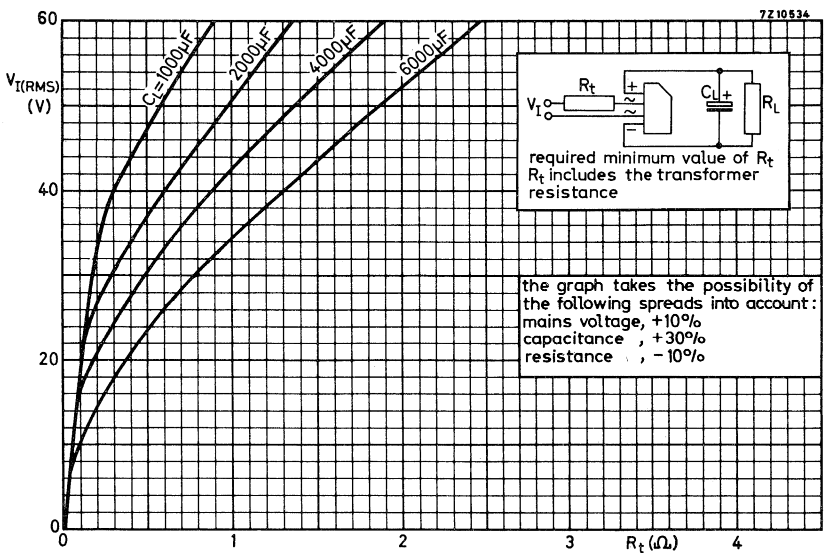
See Application Book: RECTIFIER DIODES.

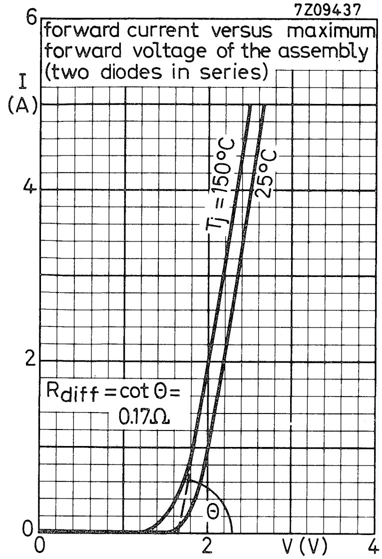
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

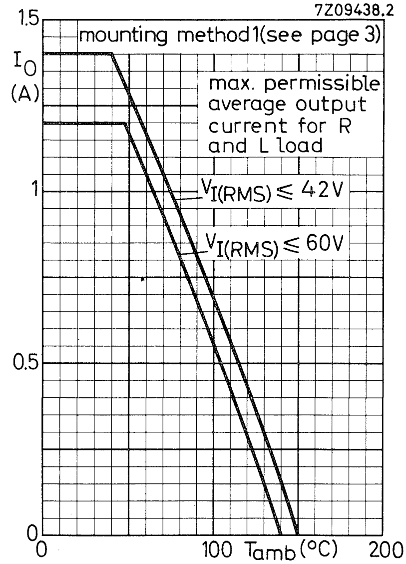
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the lower graph on page 5.

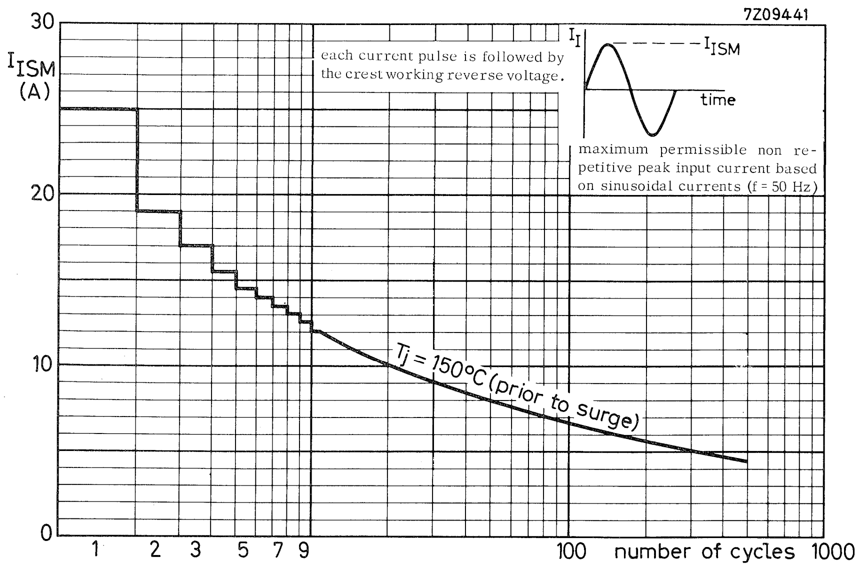
R_{diff} is shown on page 6, left hand upper figure.


7Z09442.2
P_{tot} (W)
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
mounting methods see page 3
$V_{I\,(RMS)} \leq 42\,V$
a = 4.0
3.5
3.0
2.5
2.0
1.5
1.42
Rth j-a = 40°C/W
50°C/W
55°C/W
mounting method 1
2
3
I_O (A)
T_{amb} (°C)


7Z10534
$V_{I(RMS)}$ (V)
C_L=1000µF
2000µF
4000µF
6000µF
R_t
V_I
C_L
R_L
required minimum value of R_t
R_t includes the transformer resistance
the graph takes the possibility of the following spreads into account:
mains voltage, +10%
capacitance , +30%
resistance , −10%
R_t (Ω)


7Z09437
forward current versus maximum forward voltage of the assembly (two diodes in series)
I (A)
6
4
2
0
$T_j = 150°C$
25°C
$R_{diff} = \cot \Theta = 0.17 \Omega$
Θ
0
2
V (V)
4


7Z09438.2
mounting method 1 (see page 3)
I_O (A)
1.5
1
0.5
0
max. permissible average output current for R and L load
$V_{I(RMS)} \leq 42V$
$V_{I(RMS)} \leq 60V$
0
100
T_{amb} (°C)
200


7Z09441
I_{ISM} (A)
30
20
10
0
each current pulse is followed by the crest working reverse voltage.
I_I
I_{ISM}
time
maximum permissible non repetitive peak input current based on sinusoidal currents (f = 50 Hz)
$T_j = 150°C$ (prior to surge)
1
2
3
5
7
9
100
number of cycles
1000

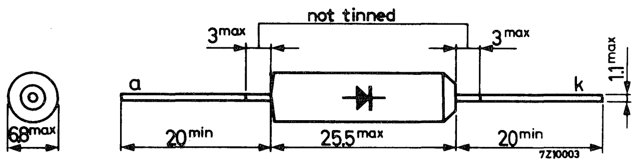
SILICON E.H.T. RECTIFIER DIODE

Silicon e.h.t. rectifier diode in a plastic envelope intended for tripler circuits, tiny-vision receivers and as focus rectifiers in colour television receivers.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	15	kV
Repetitive peak reverse voltage	V_{RRM}	max.	15	kV
Average forward current	I_{FAV}	max.	2.5	mA
Junction temperature	T_j	max.	95	^{o}C
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/μs	Q_s	typ.	5	nC

MECHANICAL DATA

Dimensions in mm



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

Voltages [1]

Crest working reverse voltage	V_{RWM}	max.	15	kV
Repetitive peak reverse voltage	V_{RRM}	max.	15	kV
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	15	kV

Currents

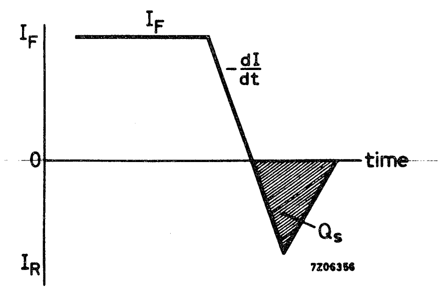
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	2.5	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA [2]
Repetitive peak reverse current during switching off	I_{RRM}	max.	150	mA

Temperatures

Storage temperature	T_{stg}	−55 to +100		°C
Junction temperature	T_j	max.	95	°C

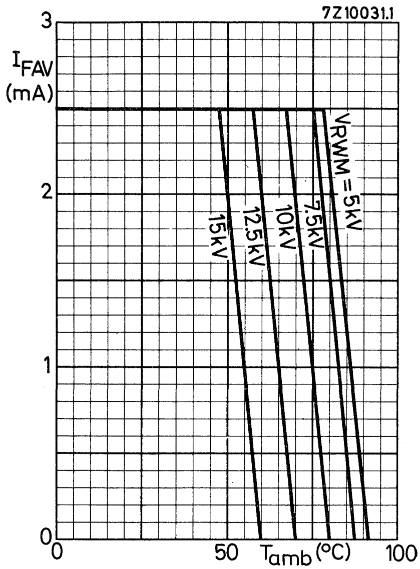
CHARACTERISTICS

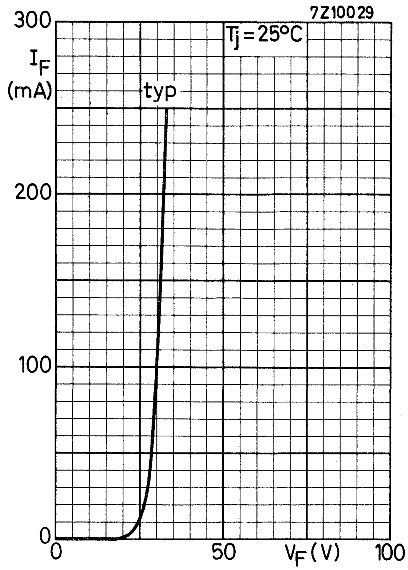
Forward voltage at I_F = 100 mA; T_j = 95 °C	V_F	<	35	V
Reverse current at V_R = 15 kV; T_j = 75 °C	I_R	<	7.0	μA
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/μs; T_j = 25 °C	Q_s	typ.	5	nC

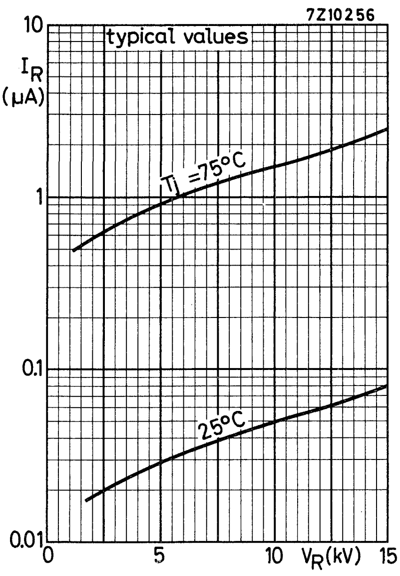


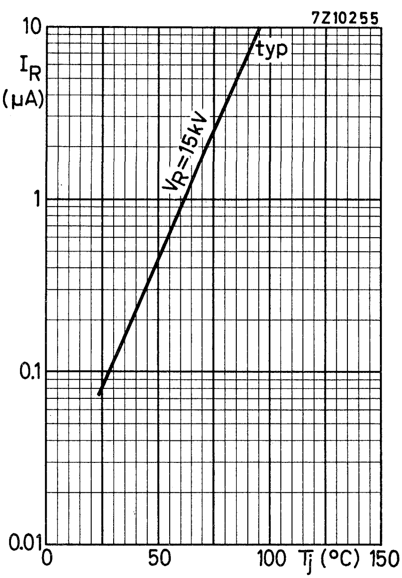
[1]) During initial line-up a reverse voltage of 17 kV is allowed at T_{amb} = 40 °C

[2]) The rectifier can withstand flash-over currents in the picture tube.


7Z10031.1
I_{FAV} (mA)
V_{RWM} = 5kV
7.5kV
10kV
12.5kV
15kV
T_{amb} (°C)


7Z10029
T_j = 25°C
I_F (mA)
typ
V_F (V)

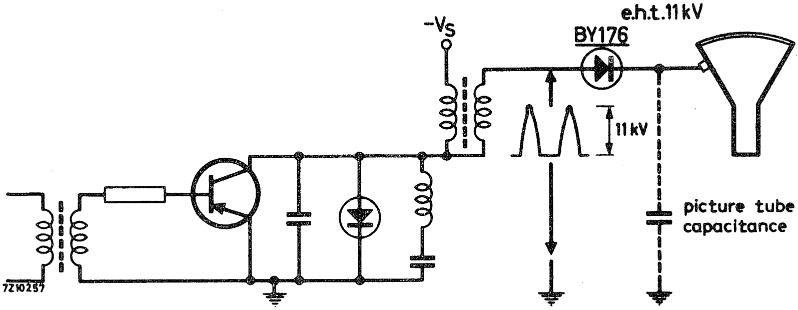

7Z10256
typical values
I_R (μA)
T_j = 75°C
25°C
V_R (kV)


7Z10255
I_R (μA)
typ
V_R = 15kV
T_j (°C)

APPLICATION INFORMATION

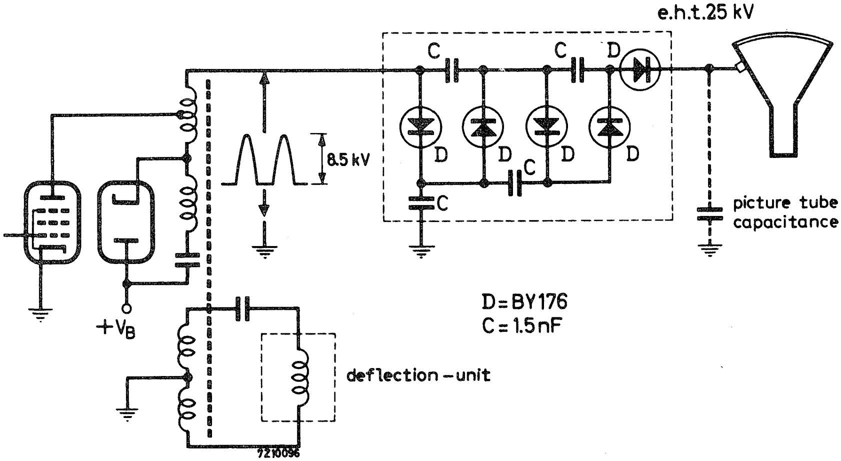
E.H.T. rectifier circuits

A.



Typical deflection circuit for small screen television receivers employing the BY176 an an e.h.t. rectifier. Proper operation of the BY176 is ensured up to an ambient temperature of 60 °C.
The contribution of the BY176 to the overall e.h.t. regulation of the circuit is negligibly small.

B.



E.H.T. supply for colour television receivers by means of a tripler circuit employing BY176 diodes. Proper operation of the BY176 diodes is ensured up to an ambient temperature of 70 °C.
Contribution to the regulation of the complete horizontal deflection output circuit due to the tripler system (inside the dashed-lines): 600 kΩ.

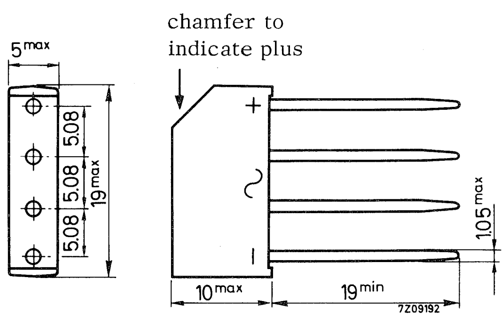
BRIDGE RECTIFIER ASSEMBLY

Plastic encapsulated bridge rectifier assembly comprising four silicon double diffused diodes.
It is primarily intended for equipment drawing its power from mains with frequencies up to 400 Hz.

QUICK REFERENCE DATA				
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.	1	A
Repetitive peak current	I_{ORM}	max.	5	A

MECHANICAL DATA

Dimensions in mm



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

All information applies to mains frequencies up to 400 Hz.

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

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; $t \leq 10$ ms	V_{ISM}	max.	800	V
Non repetitive peak current (see also page 6)	I_{ISM}	max.	25	A

Output

Average current with C load	See pages 4 and 5			
Average current with R and L load up to T_{amb} = 40 °C (see also page 5)	I_O	max.	1	A
Repetitive peak current	I_{ORM}	max.	5	A

Temperatures

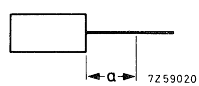
Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

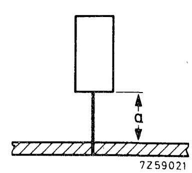
Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

The quoted values apply when no other leads run to the tie−points. If leads of other dissipating components share the same tie−points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead−length a > 5 mm. $R_{th\ j\text{-}a}$ = 40 °C/W

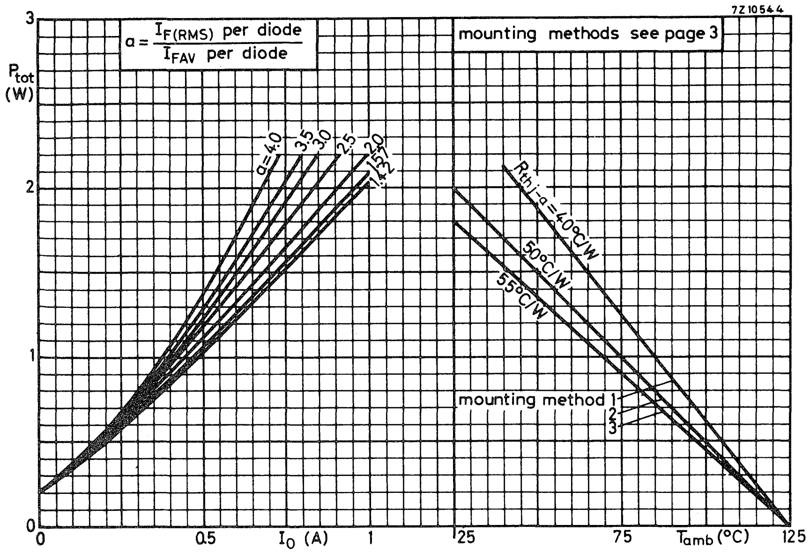


2. Mounted on printed−wiring board at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 50 °C/W
3. Mounted on printed−wiring board at a lead−length a = 5 mm. $R_{th\ j\text{-}a}$ = 55 °C/W



SOLDERING AND MOUNTING NOTES

1. The maximum permissible contact time for the soldering iron or bath is 3 seconds.
2. If the soldered joints are at least 5 mm from the seal, the maximum permissible temperature of the soldering iron or bath is 270 °C. If the joints are between 1.5 mm (min) and 5 mm from the seal, the maximum permissible temperature is 250 °C.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

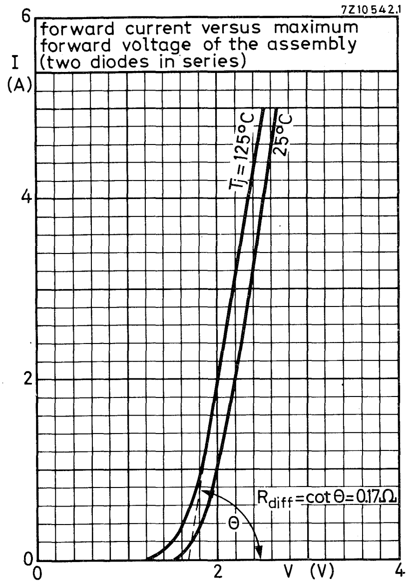


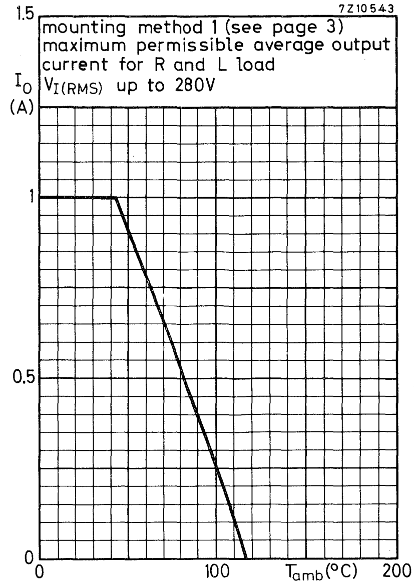
From the lefthand graph the total power dissipation can be found as a function of the average output current.

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.

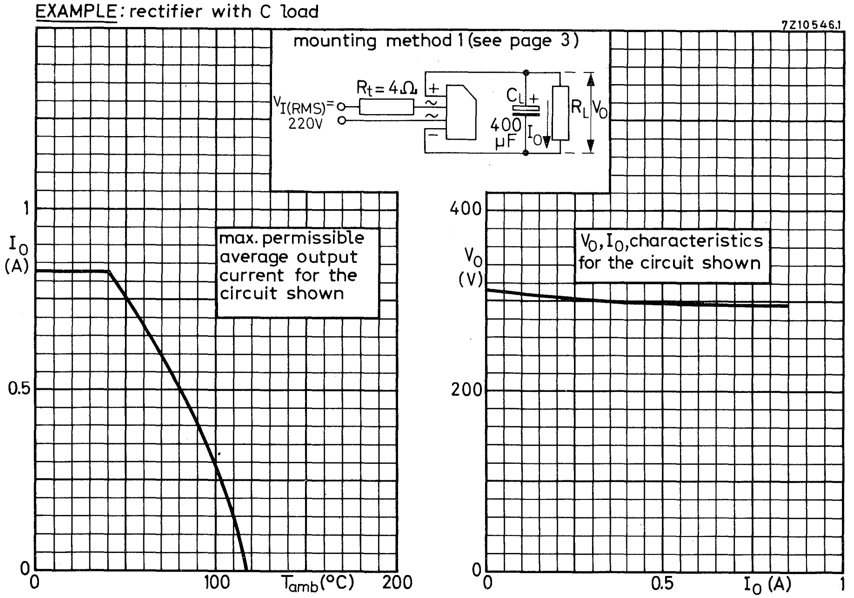
See Application Book: RECTIFIER DIODES.
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

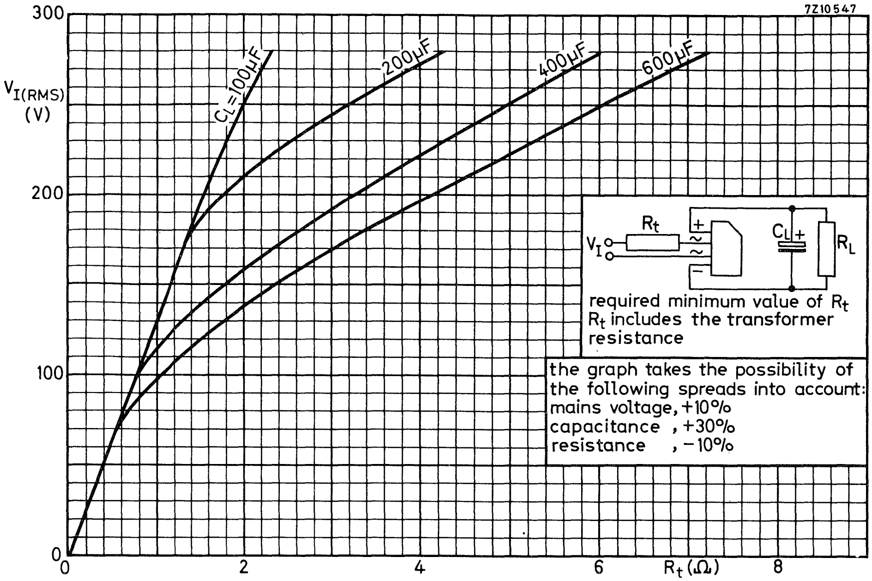
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph on page 6.
R_{diff} is shown on page 5, left hand upper graph.

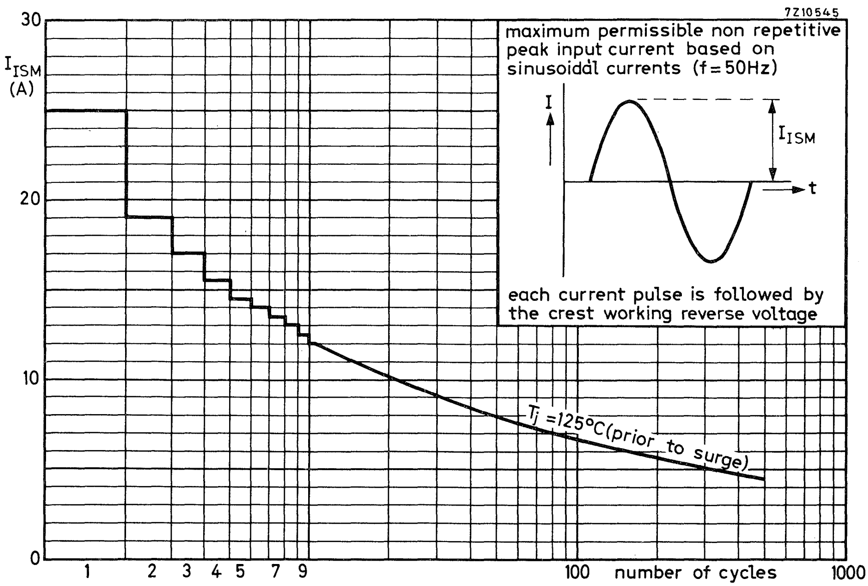




EXAMPLE: rectifier with C load




7Z10547
300
200
100
0
$V_{I(RMS)}$
(V)
C_L=100µF
200µF
400µF
600µF
0
2
4
6
R_t (Ω)
8
R_t
V_I
C_L
R_L
required minimum value of R_t
R_t includes the transformer resistance
the graph takes the possibility of the following spreads into account:
mains voltage, +10%
capacitance , +30%
resistance , −10%


7Z10545
30
20
10
0
I_{ISM}
(A)
1
2
3
4
5
7
9
100
number of cycles
1000
maximum permissible non repetitive peak input current based on sinusoidal currents (f = 50Hz)
I
I_{ISM}
t
each current pulse is followed by the crest working reverse voltage
T_j = 125°C (prior to surge)

SILICON HIGH VOLTAGE DIODE

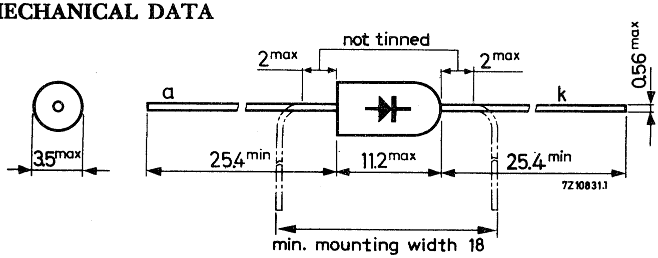
Diode in a plastic envelope intended for use as V_{g2} supply in colour television receivers.

QUICK REFERENCE DATA

Crest working reverse voltage	V_{RWM}	max.	1500	V
Repetitive peak reverse voltage	V_{RRM}	max.	1800	V
Average forward current	I_{FAV}	max.	2.0	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Junction temperature	T_j	max.	75	°C
Recovered charge when switched from $I_F = 10$ mA to $V_R = 2$ V with $-\frac{dI}{dt} = 5$ mA/μs	Q_s	typ.	1	nC

MECHANICAL DATA

Dimensions in mm



The envelope fulfils the accelerated damp heat test described in I.E.C. publication 68-2 (test D, severity IV, 6 cycles).

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

Voltages

Crest working reverse voltage	V_{RWM}	max.	1500	V
Repetitive peak reverse voltage	V_{RRM}	max.	1800	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	1800	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	2.0	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Non repetitive peak forward current ($t \leq 10$ ms)	I_{FSM}	max.	1000	mA

Temperatures

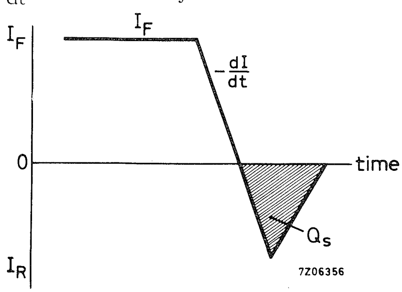
Storage temperature	T_{stg}		−65 to +100	^{o}C
Junction temperature	T_j	max.	75	^{o}C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	175	^{o}C/W

CHARACTERISTICS

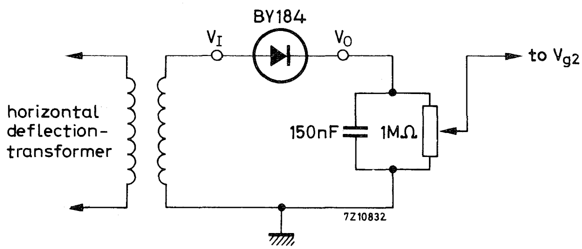
Forward voltage at $I_F = 100$ mA; $T_j = 75\ ^{o}$C	V_F	<	5	V
Reverse current at $V_R = 1500$ V; $T_j = 75\ ^{o}$C	I_R	<	10	μA
Recovered charge when switched from $I_F = 10$ mA to $V_R = 2$ V with $-\frac{dI}{dt} = 5$ mA/μs; $T_j = 25\ ^{o}$C	Q_s	typ.	1	nC

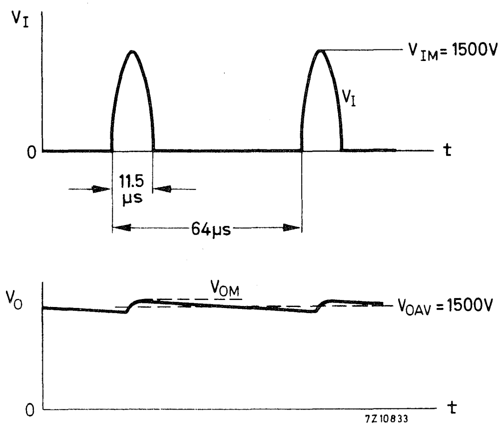


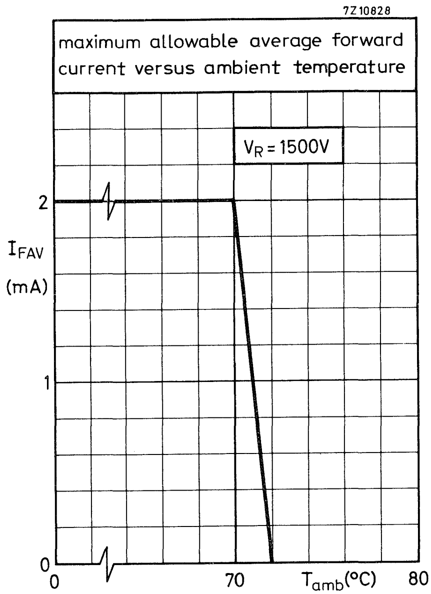
APPLICATION INFORMATION

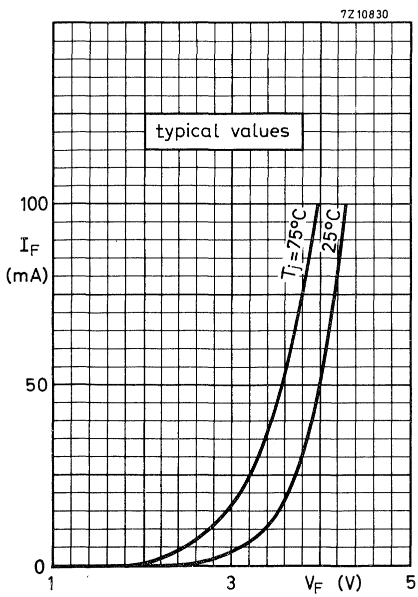
Basic circuit for V_{g2} supply in colour television receivers.

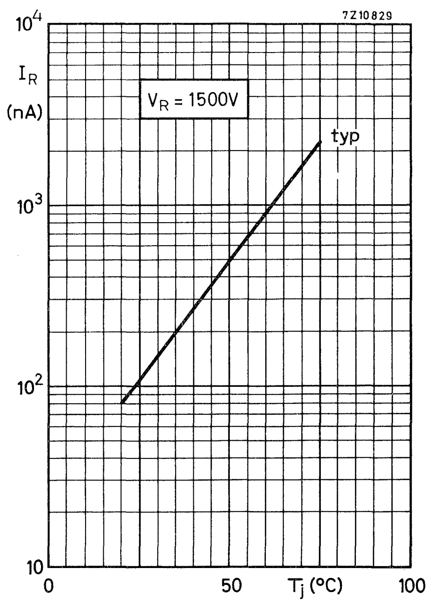
Stable continuous operation is ensured at an ambient temperature up to 70 °C






7Z10828
maximum allowable average forward current versus ambient temperature
V_R = 1500V
2
I_FAV
(mA)
1
0
0
70
T_amb(°C)
80


7Z10830
typical values
100
I_F
(mA)
50
0
T_j = 75°C
25°C
1
3
V_F (V)
5


7Z10829
10^4
I_R
(nA)
V_R = 1500V
typ
10^3
10^2
10
0
50
T_j (°C)
100

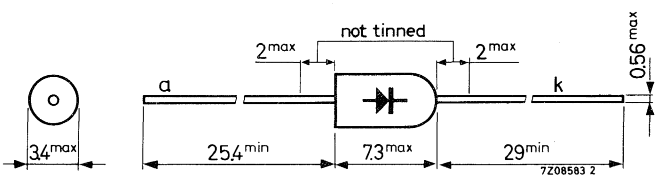
SILICON RECTIFIER DIODE

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 R and L load; $V_{RWM} = V_{RWMmax}$	I_{FAV}	max.	0.36	A
$V_{RWM} = 60$ V	I_{FAV}	max.	0.5	A
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	150	°C

MECHANICAL DATA Dimensions in mm

DO-14



The sealing of the plastic envelope withstands the accelerated damp heat test of I. E. C. recommendation 68–2 (test D, severity IV, 6 cycles).

MOUNTING METHODS see page 3.

All information applies to frequencies up to 400 Hz.

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

Voltages

Crest working reverse voltage	V_{RWM}	max.	800	V
Repetitive peak reverse voltage	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 R and L load; $V_{RWM} = V_{RWMmax}$	I_{FAV}	max.	0.36	A
$V_{RWM} = 60$ V	I_{FAV}	max.	0.5	A
for capacitive load		see page 4		
Repetitive peak forward current	I_{FRM}	max.	3	A
Non-repetitive peak forward current ($t = 10$ ms; half-sine wave)	I_{FSM}	max.	15	A

Temperatures

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

THERMAL RESISTANCE See page 3

CHARACTERISTICS

Forward voltage at $I_F = 2$ A; $T_j = 25$ °C	V_F	<	1.6	V [1]
Reverse current at $V_R = 800$ V; $T_j = 125$ °C	I_R	<	50	μA

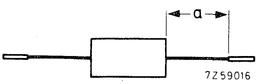
[1] Measured under pulsed conditions to avoid excessive dissipation.

THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

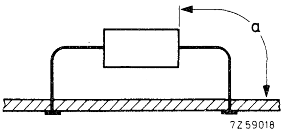
The quoted values apply when no other leads run to the tie–points. If leads of other dissipating components share the same tie–points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead–length a = 10 mm. $R_{th\ j\text{-}a}$ = 150 ^{o}C/W



2. Mounted to solder tags at a = maximum lead–length. $R_{th\ j\text{-}a}$ = 200 ^{o}C/W

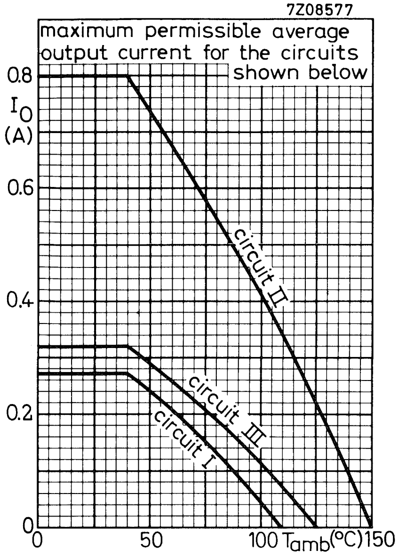
3. Mounted on printed–wiring with a small area of copper at any lead–length a. $R_{th\ j\text{-}a}$ = 200 ^{o}C/W

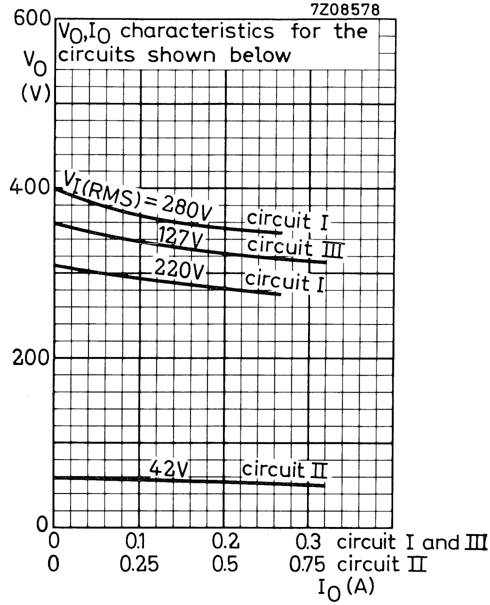


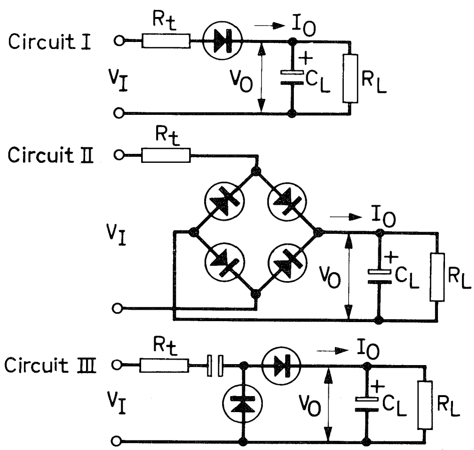
SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 ^{o}C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 ^{o}C.

EXAMPLE: Rectifier with C-load
mounting method 1 (see page 3)



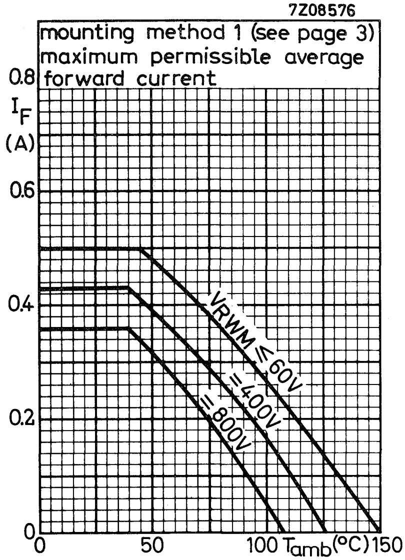


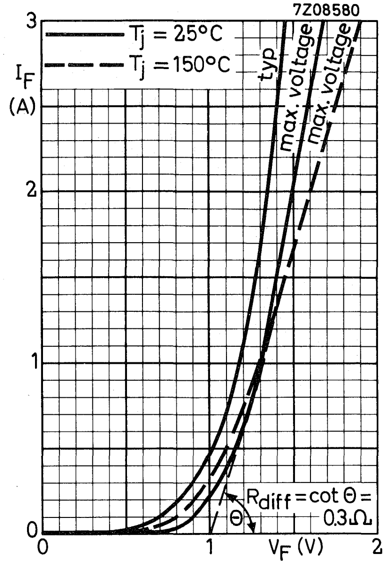


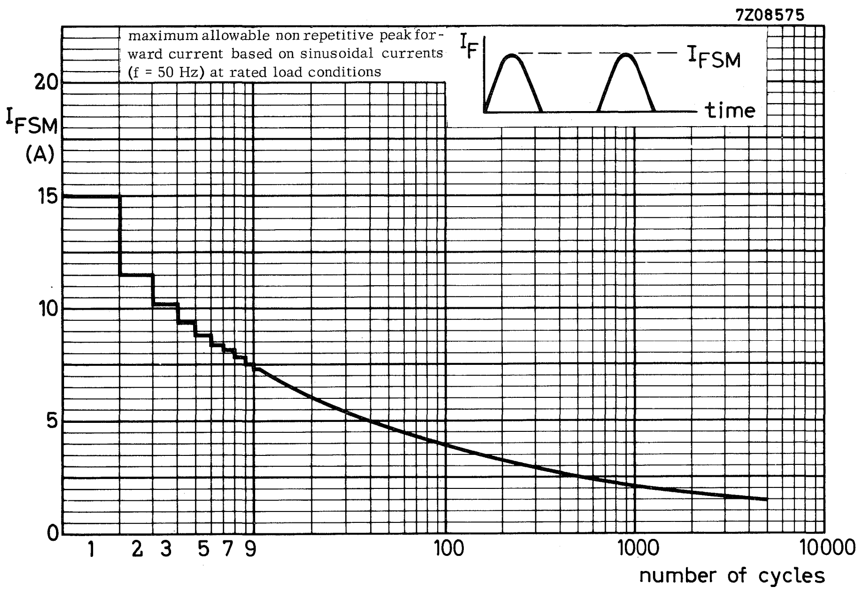
	$V_{I(RMS)}$	R_t	C_L
Circuit I	220V	8.2 Ω	100 µF
	280V	15 Ω	100 µF
Circuit II	42V	1.5 Ω	1500 µF
Circuit III	127V	5.6 Ω	200 µF

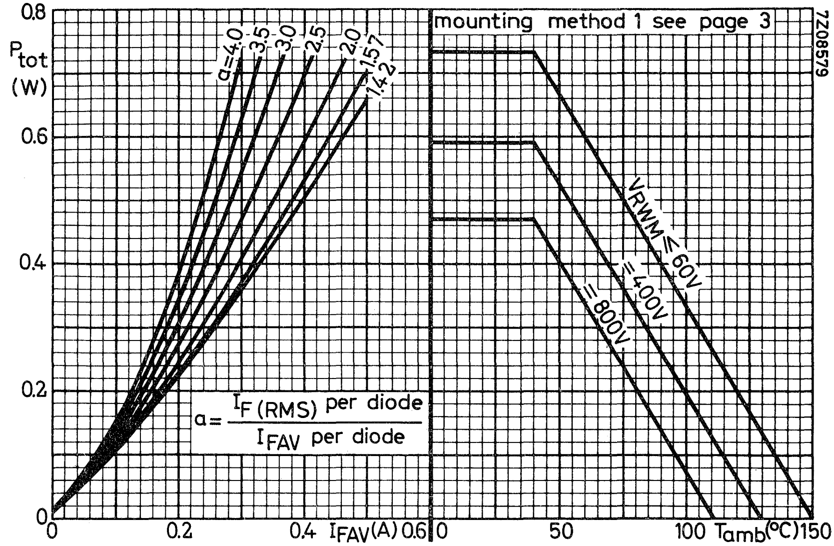
7Z08584

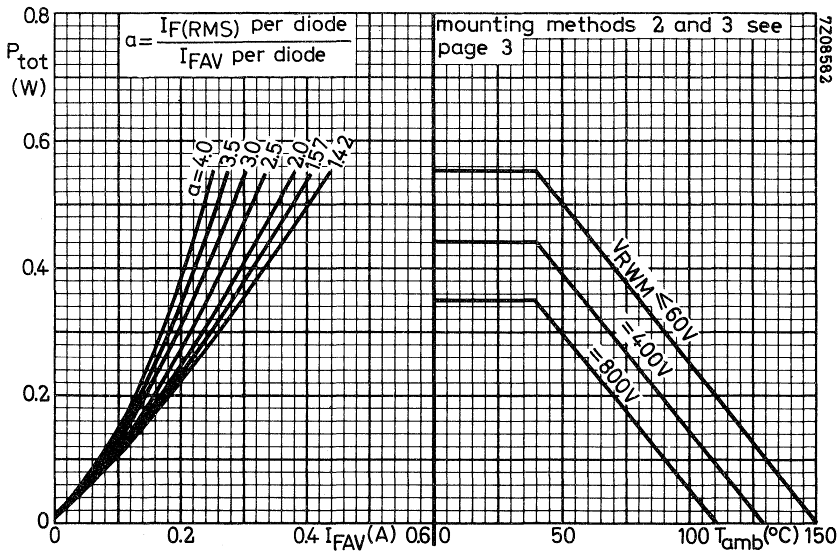
R AND L-LOAD

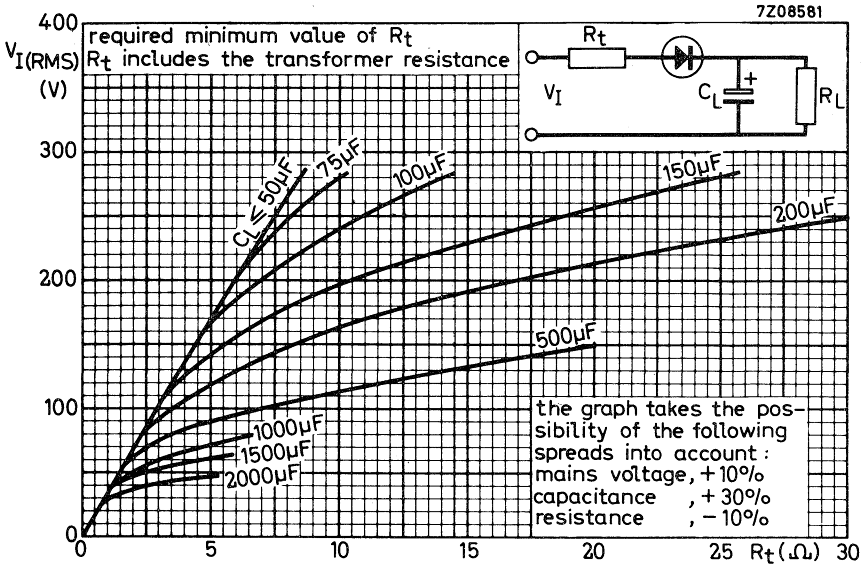

7Z08576
mounting method 1 (see page 3)
maximum permissible average
forward current
I_F (A)
0.8
0.6
0.4
0.2
0
$V_{RWM} \leq 60V$
$\leq 400V$
$\leq 800V$
0
50
100
150
T_{amb} (°C)


7Z08580
$T_j = 25°C$
$T_j = 150°C$
typ
max. voltage
max. voltage
I_F (A)
3
2
1
0
$R_{diff} = \cot\Theta = 0.3\Omega$
Θ
0
1
2
V_F (V)


7Z08575
maximum allowable non repetitive peak forward current based on sinusoidal currents (f = 50 Hz) at rated load conditions
I_F
I_{FSM}
time
I_{FSM} (A)
20
15
10
5
0
1
2
3
5
7
9
100
1000
10000
number of cycles


0.8
P_{tot} (W)
0.6
0.4
0.2
0
a=4.0
3.5
3.0
2.5
2.0
1.57
1.42
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
0
0.2
0.4 I_{FAV}(A) 0.6
mounting method 1 see page 3
7Z08579
$V_{RWM} \leq 60V$
= 400V
= 800V
0
50
100 T_{amb}(°C) 150


0.8
P_{tot} (W)
0.6
0.4
0.2
0
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
a=4.0
3.5
3.0
2.5
2.0
1.57
1.42
0
0.2
0.4 I_{FAV}(A) 0.6
mounting methods 2 and 3 see page 3
7Z08582
$V_{RWM} \leq 60V$
= 400V
= 800V
0
50
100 T_{amb}(°C) 150



From the left hand graph on page 6 the total power dissipation can be found as a function of the average output current.

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

See Application Book: RECTIFIER DIODES

Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph.

R_{diff} is shown on page 5 upper figure.

SILICON RECTIFIER DIODES

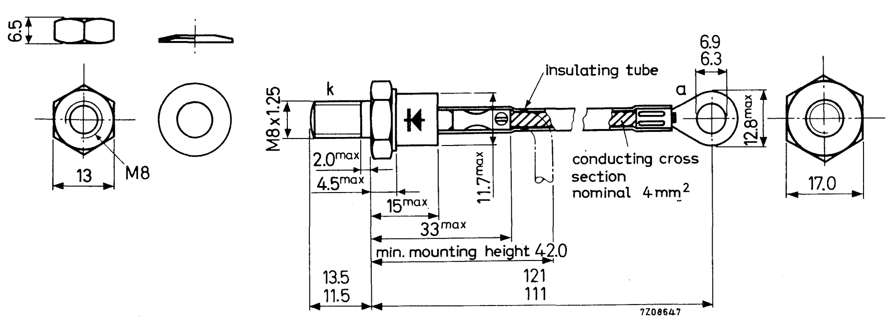
Double diffused silicon diodes in metal envelopes, intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud) BYX13-800 to 1200

Reverse polarity (anode to stud) BYX13-800R to 1200R

QUICK REFERENCE DATA

			BYX13-800(R)	1000(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	800	1000	1200	V
Average forward current	I_{FAV}	max.		20		A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 125$ °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



The mark shown applies to normal polarity types and blue cables.

Reverse polarity types: reversed symbol and red cable

Net weight : 35 g
Diameter of clearance hole: max. 8.5 mm.

Torque on nut: min. 40 kg cm
max. 60 kg cm

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

Voltages		BYX13-800(R)	1000(R)	1200(R)	
Continuous reverse voltage	V_R	max. 400	500	600	V
Crest working reverse voltage	V_{RWM}	max. 400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max. 800	1000	1200	V
Non-repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max. 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; $T_j = 125$ °C	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

CHARACTERISTICS

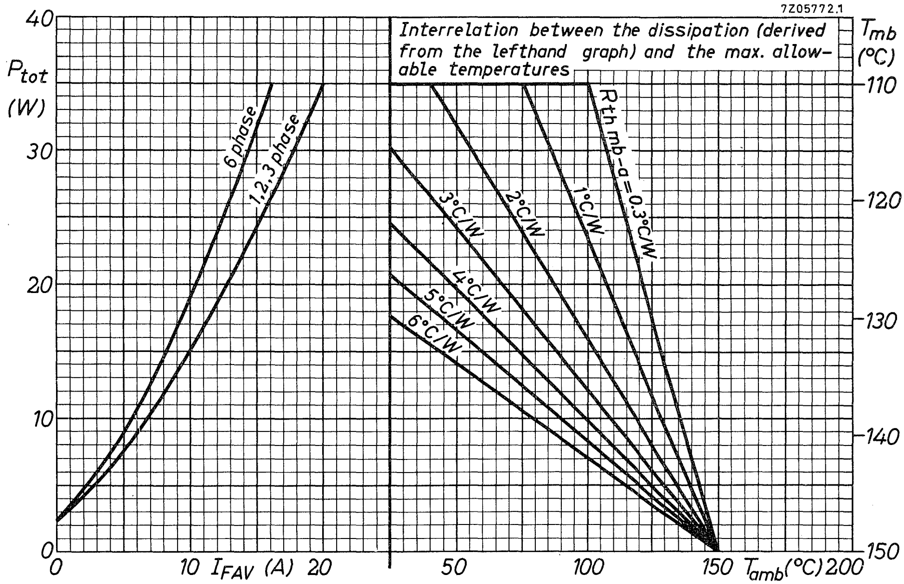
Forward voltage at $T_j = 25$ °C

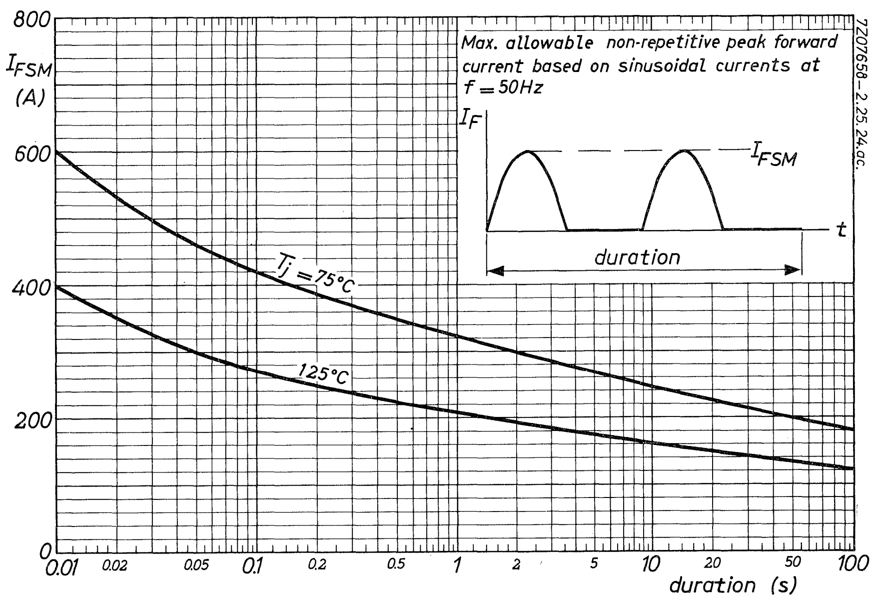
$I_F = 1$ A	V_F	<	0.9	V
$I_F = 100$ A	V_F	<	2.0	V [1]

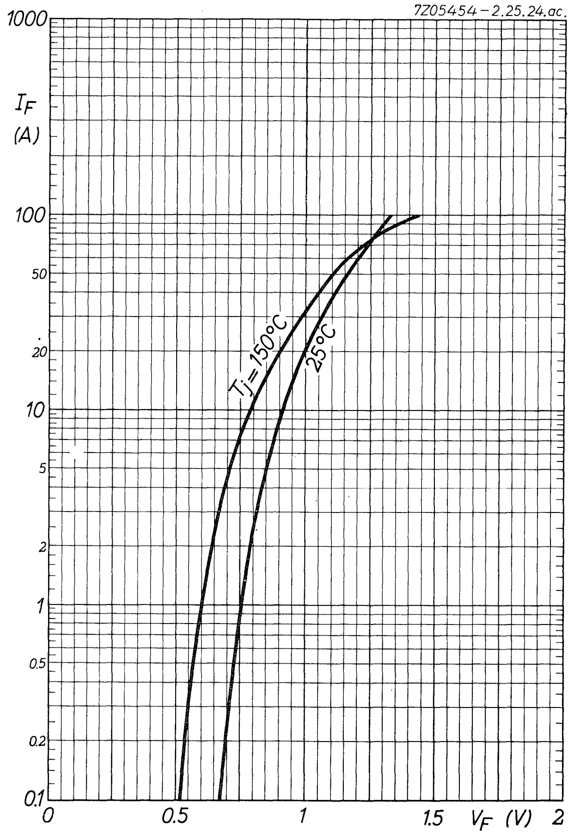
Reverse current at $T_j = 125$ °C

		BYX13-800(R)	1000(R)	1200(R)
$V_R = V_{RWMmax}$	I_R	< 2.0	1.7	1.4 mA

[1]) Measured under pulsed conditions to avoid excessive dissipation


7Z05772.1
Interrelation between the dissipation (derived from the lefthand graph) and the max. allowable temperatures
P_{tot} (W)
T_{mb} (°C)
6 phase
1,2,3 phase
3°C/W
2°C/W
1°C/W
$R_{th\ mb-a}$ = 0.3°C/W
4°C/W
5°C/W
6°C/W
I_{FAV} (A)
T_{amb} (°C)


7Z07658-2.25.24.ac.
Max. allowable non-repetitive peak forward current based on sinusoidal currents at f = 50Hz
I_{FSM} (A)
I_F
I_{FSM}
t
duration
T_j = 75°C
125°C
duration (s)



APPLICATION INFORMATION AND OPERATING NOTES

See general pages at the beginning of this section.

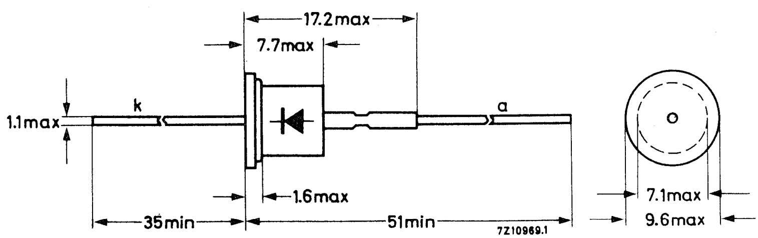
SILICON RECTIFIER DIODES

The BYX22-600 and BYX22-1200 are silicon diodes in a metal DO-1 envelope, intended for power rectifier applications up to 1.4 A.

QUICK REFERENCE DATA					
			BYX22-600	1200	
Crest working reverse voltage	V_{RWM}	max.	400	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	600	1200	V
Average forward current	I_{FAV}	max.	1.4		A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 150$ °C	I_{FSM}	max.	40		A
Junction temperature	T_j	max.	150		°C
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	60		°C/W

MECHANICAL DATA Dimensions in mm

DO-1



MOUNTING METHODS see page 3

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

All information applies to frequencies up to 400Hz

Voltages

		BYX22-600	1200	
Crest working reverse voltage	V_{RWM}	max. 400	800	V
Repetitive peak reverse voltage ($d \leq 1\%$)	V_{RRM}	max. 600	1200	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max. 600	1200	V

Currents

Average forward current (averaged over any 20 ms period) for R-load up to $T_{amb} = 30\ ^oC$	I_{FAV}	max.	1.4	A
Forward current (d.c.) up to $T_{amb} = 30\ ^oC$	I_F	max.	1.6	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Non repetitive peak forward current $t = 10$ ms; $T_j = 150\ ^oC$ (see page 6)	I_{FSM}	max.	40	A

Temperatures

Storage temperature	T_{stg}		-65 to +150	^oC
Ambient temperature	T_{amb}	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient $R_{th\ j-a}$ See page 3

CHARACTERISTICS

Forward voltage at $I_F = 5A$; $T_{amb} = 25\ ^oC$	V_F	<	1.5	V [1]
Reverse current at $V_R = V_{RWMmax}$; $T_{amb} = 125\ ^oC$	I_R	<	120	μA

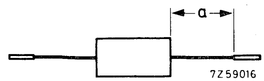
[1]) Measured under pulsed conditions to avoid excessive dissipation.

THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

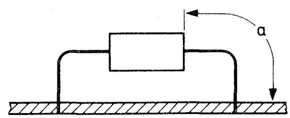
The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 60 ^{o}C/W



2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 70 ^{o}C/W

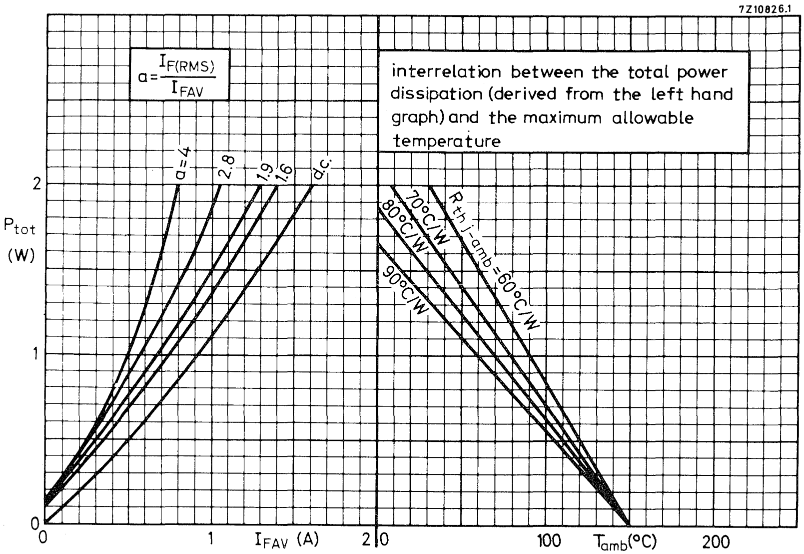
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 80 ^{o}C/W



4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 90 ^{o}C/W

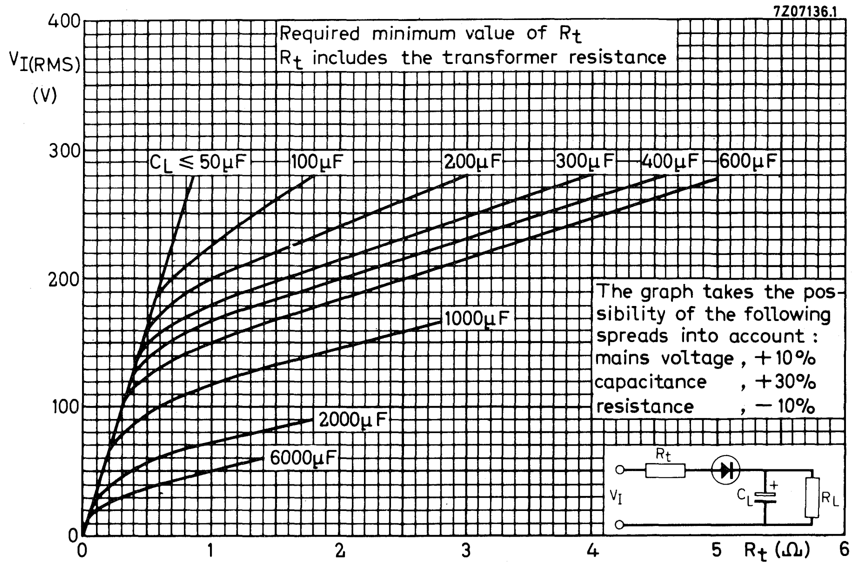
SOLDERING AND MOUNTING NOTES

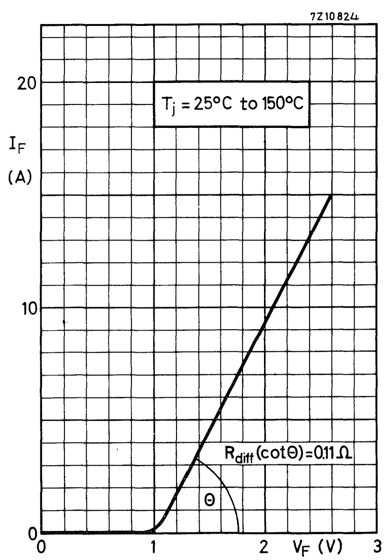
1. At a soldering iron or bath temperature of up to 245 ^{o}C, the maximum permissible soldering time is 10 s if the joint is 5 mm from the seal, 3 s if it is 1.5 mm from the seal.
2. At a temperature between 245 ^{o}C and 400 ^{o}C (max.), the joint must be more than 5 mm from the seal and soldering time must not exceed 5 s.
3. Leads should not be bent less than 1.5 mm from the seal; excert no axial pull when bending.

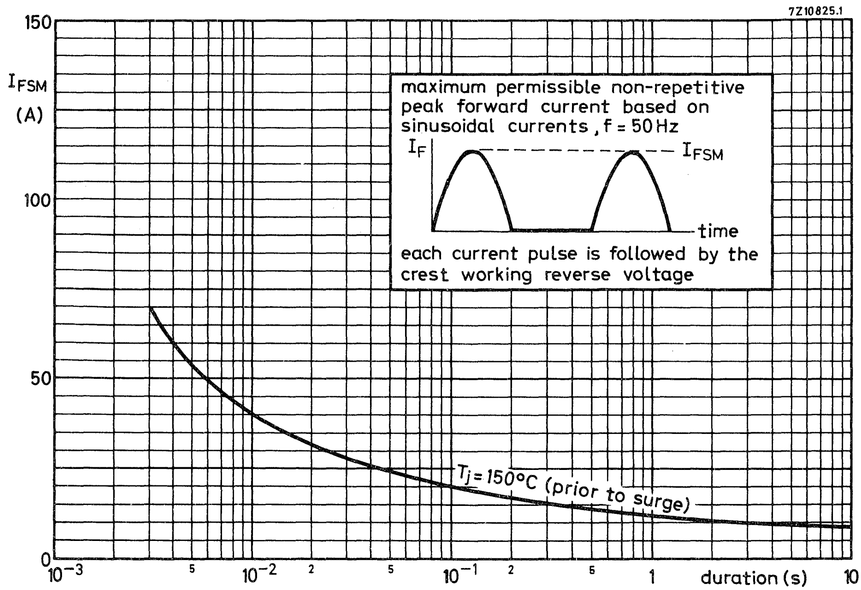


The form factor $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $n\omega R_L C_L$ and $\frac{R_t + R_{diff}}{nR_L}$ and can be found from existing graphs.

See Application Book: RECTIFIER DIODES.


7Z07136.1
Required minimum value of R_t
R_t includes the transformer resistance
$V_{I(RMS)}$ (V)
400
300
200
100
0
$C_L \leq 50\mu F$
100µF
200µF
300µF
400µF
600µF
1000µF
2000µF
6000µF
The graph takes the possibility of the following spreads into account :
mains voltage , +10%
capacitance , +30%
resistance , −10%
R_t
V_I
C_L
R_L
0
1
2
3
4
5
R_t (Ω)
6


7Z10824
T_j = 25°C to 150°C
I_F (A)
20
10
0
R_{diff} (cotΘ)=0.11Ω
Θ
0
1
2
V_F (V)
3


7Z10825.1
150
I_{FSM}
(A)
100
50
0
maximum permissible non-repetitive peak forward current based on sinusoidal currents, f = 50 Hz
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
T_j = 150°C (prior to surge)
10^{-3}
5
10^{-2}
2
5
10^{-1}
2
5
1
duration (s)
10

CONTROLLED AVALANCHE RECTIFIER DIODES

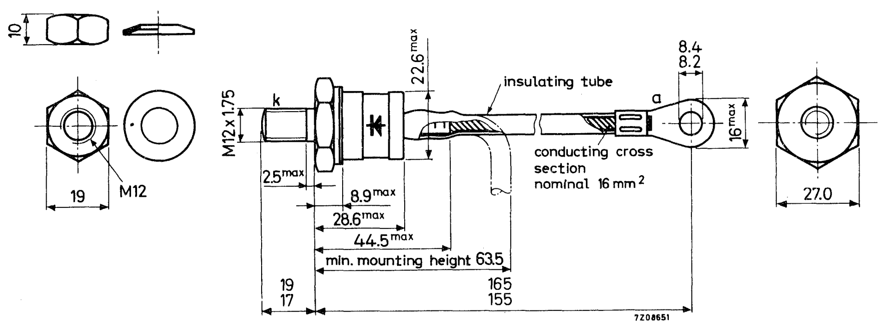
Diffused silicon diodes in metal envelopes with ceramic insulation, capable of absorbing transients and intended for power rectifier application.
The series consists of normal polarity types (cathode to stud) BYX23-400 to -1000.

QUICK REFERENCE DATA

			BYX23 – 400	600	800	1000	
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	500	750	1000	1250	V
Average forward current up to $T_{mb} = 100\ ^{o}C$	$I_{F(AV)}$	max.	150				A
at $T_{mb} = 125\ ^{o}C$	$I_{F(AV)}$	max.	115				A
Non-repetitive peak forward current $t = 10\ ms$; $T_j = 190\ ^{o}C$ prior to surge	I_{FSM}	max.	1600				A
Non-repetitive peak reverse power dissipation ($t = 10\ \mu s$; $T_j = 25\ ^{o}C$)	P_{RSM}	max.	30				kW
Operating junction temperature	T_j	max.	190				^{o}C

MECHANICAL DATA

Dimensions in mm



Net weight: 115 g
Diameter of clearance hole: max. 13.0 mm

Torque on nut: min. 100 kg cm
(10 Newton-metres)
max. 250 kg cm
(25 Newton-metres)

All information applies to frequencies up to 400 Hz.

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

Voltages [1]

			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) up to $T_{mb} = 100\ ^oC$	$I_{F(AV)}$	max	150	A
at $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	115	A
Forward current (d. c.)	I_F	max.	240	A
R. M. S. forward current	$I_{F(RMS)}$	max.	240	A
Repetitive peak forward current	I_{FRM}	max.	750	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) $T_j = 190\ ^oC$ prior to surge	I_{FSM}	max.	1600	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	12800	A^2s

Reverse power dissipation

Average reverse power dissipation (averaged over any 20 ms period)	$P_{R(AV)}$	max.	30	W
Repetitive peak reverse power dissipation $t = 10\ \mu s$ (square wave; $f = 50$ Hz) $T_j = 190\ ^oC$	P_{RRM}	max.	8	kW
Non-repetitive peak reverse power dissipation; $t = 10\ \mu s$ (square wave) see page 5 $T_j = 25\ ^oC$ prior to surge	P_{RSM}	max.	30	kW
$T_j = 190\ ^oC$ prior to surge	P_{RSM}	max.	15	kW

Temperatures

Storage temperature	T_{stg}		-55 to +200	^oC
Operating junction temperature	T_j	max.	190	^oC

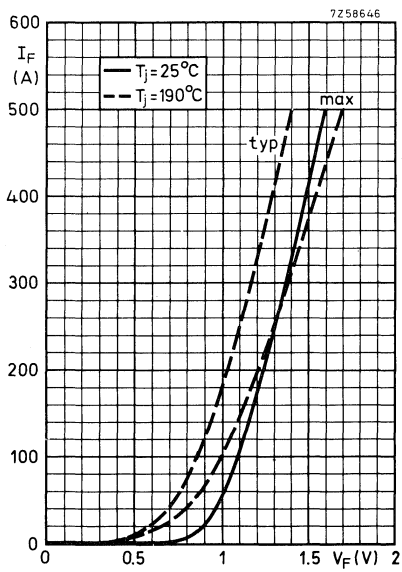
[1] To ensure thermal stability: $R_{th\ j-a} < 0.75\ ^oC/W$ (continuous reverse voltage) or $< 1.5\ ^oC/W$ (a.c.).
For smaller heatsinks T_j should be derated. For a. c. see page 5 upper graph.
For continuous reverse voltage: $R_{th\ j-a} = 1\ ^oC/W$, then $T_{j\,max} = 184\ ^oC$
$R_{th\ j-a} = 1.2\ ^oC/W$, then $T_{j\,max} = 180\ ^oC$
$R_{th\ j-a} = 1.5\ ^oC/W$, then $T_{j\,max} = 175\ ^oC$

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	0.4	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb-h}$	=	0.1	°C/W
with heatsink compound (e.g. Dow Corning 340)	$R_{th\ mb-h}$	=	0.04	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j-mb}$	=	0.025	°C/W

CHARACTERISTICS

			BYX23 - 400	600	800	1000	
Forward voltage I_F = 500 A; T_j = 25 °C	V_F	<	1.6	1.6	1.6	1.6	V[1]
Reverse avalanche breakdown voltage I_R = 10 mA; T_j = 25 °C	$V_{(BR)R}$	>	500	750	1000	1250	V
		<	1600	1600	1600	1600	V
Peak reverse current $V_{RM} = V_{RWM\,max}$; T_j = 175 °C	I_{RM}	<	30	24	18	15	mA



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

OPERATING NOTES (see also general pages at the beginning of this section)

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:

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

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 5. 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. ($n.E_D$)

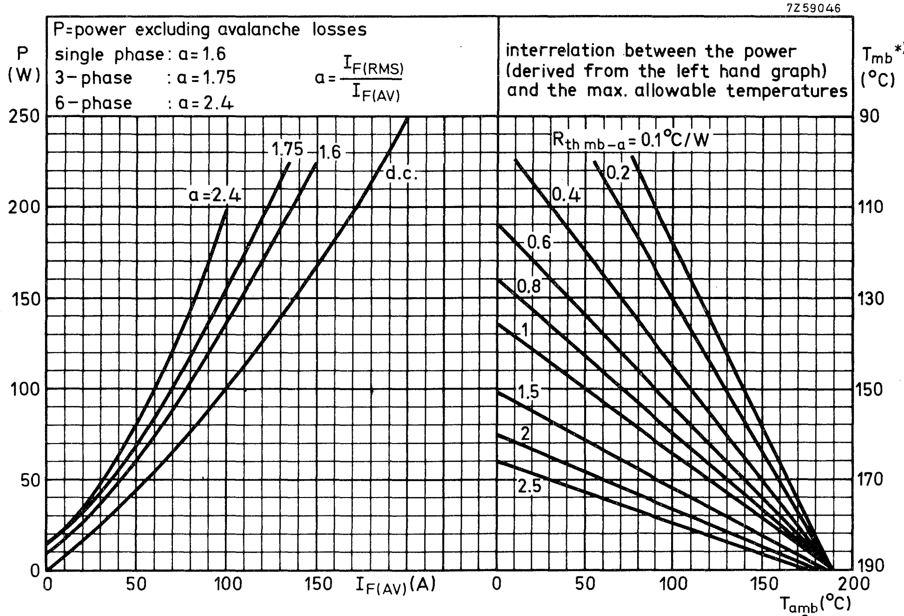
The difference between the energy released by the transformer and that absorbed by the n diodes should be absorbed by series connected R and C elements across the secondary winding of the transformer.
The magnitudes of R and C have to be derived from the following formulae:

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

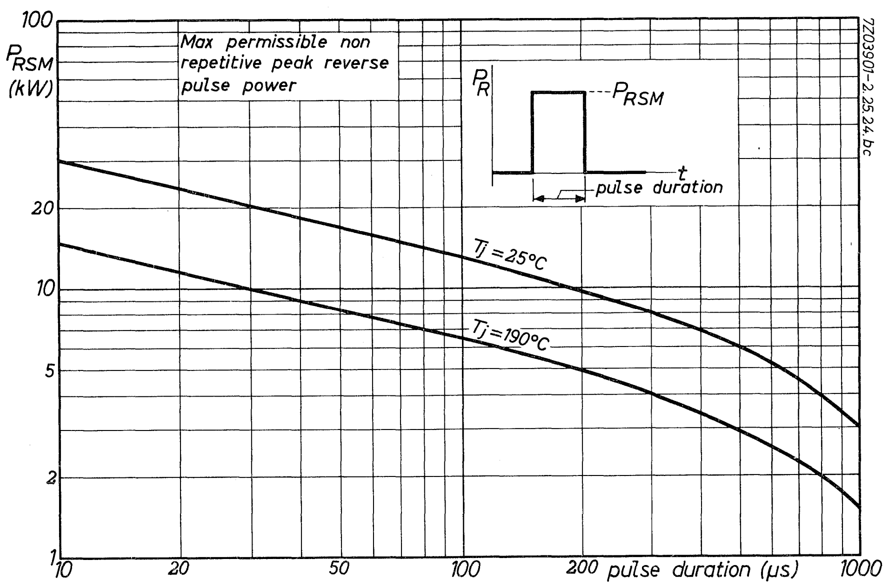
where C = capacitance in μF
E_T = energy released by the transformer in Ws
n = number of diodes in series
E_D = energy absorbed by one diode in Ws
$V_{(BR)R\,min}$ = minimum reverse breakdown voltage of one diode in V
R = resistance in Ω

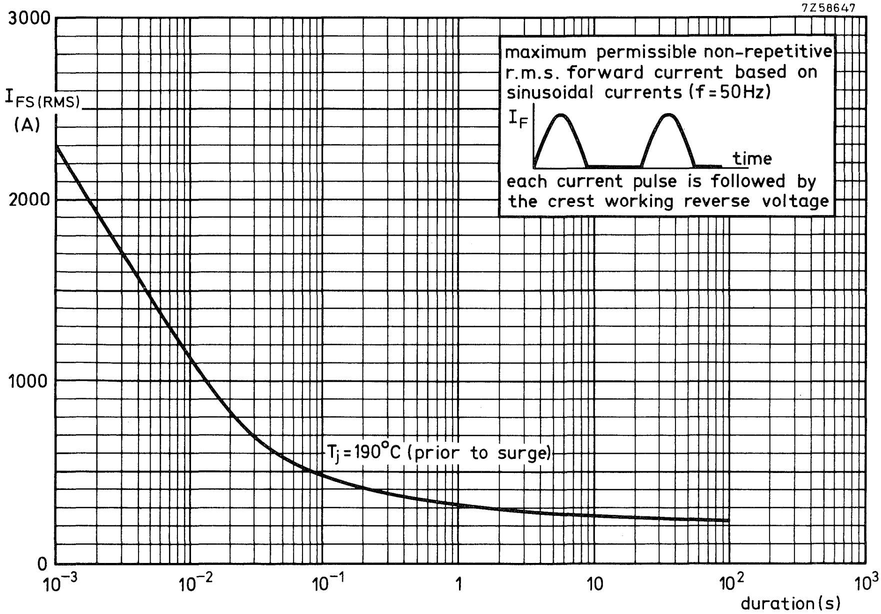
APPLICATION INFORMATION

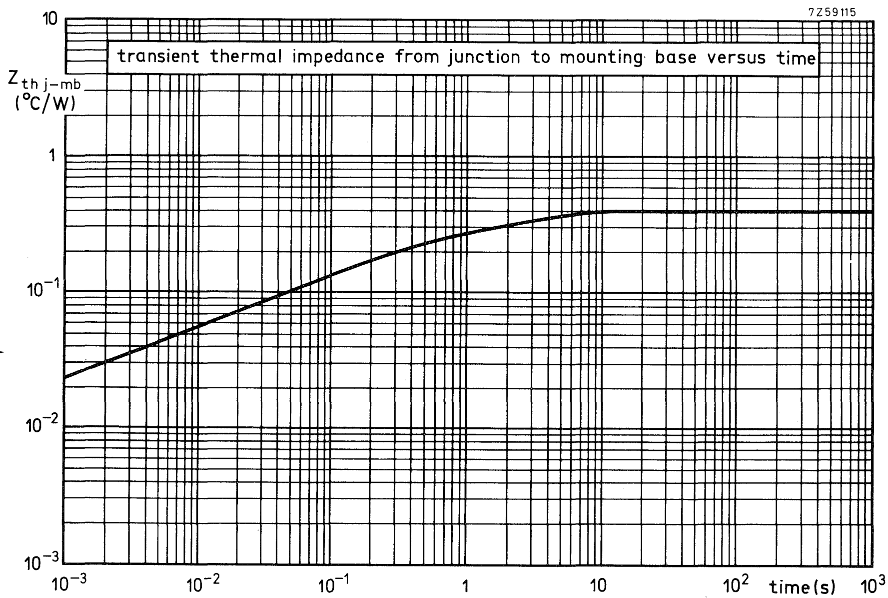
See general pages at the beginning of this section.



*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.1\ ^{\circ}C/W$




7Z58647
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
I_FS(RMS)
(A)
3000
2000
1000
0
T_j = 190°C (prior to surge)
10^-3
10^-2
10^-1
1
10
10^2
10^3
duration (s)


7Z59115
transient thermal impedance from junction to mounting base versus time
Z_th j-mb
(°C/W)
10
1
10^-1
10^-2
10^-3
10^-3
10^-2
10^-1
1
10
10^2
time (s)
10^3

CONTROLLED AVALANCHE RECTIFIER 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.

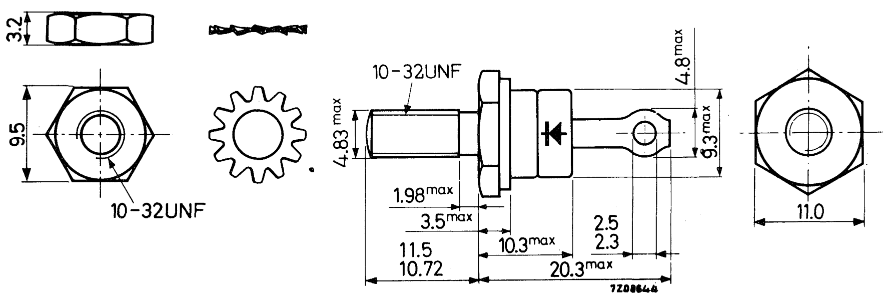
QUICK REFERENCE DATA

			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 ^oC	P_{RRM}	max.		3.0		kW
Non repetitive peak reverse power t = 10 μs; T_j = 25 ^oC	P_{RSM}	max.		18		kW
Junction temperature	T_j	max.		175		^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=		1.3		$^oC/W$

MECHANICAL DATA

Dimensions in mm

DO-4



Net weight : 5.6 g
With accessories: 7.6 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295, (56262A)

Torque on nut: min. 8 cm kg
max. 17 cm kg
The mark shown applies to normal polarity types.

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 7)	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 6) 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] To ensure thermal stability: $R_{th\ j\text{-}a} < 2.5$ °C/W (d.c.) or < 5 °C/W (a.c.)
For smaller heatsinks $T_{j\ max.}$ should be derated. For a.c. see page 5).
For d.c.: if $R_{th\ j\text{-}a}$ = 5 °C/W, then $T_{j\ max.}$ = 135 °C,
if $R_{th\ j\text{-}a}$ = 10 °C/W, then $T_{j\ max.}$ = 120 °C.

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

			BYX25-600(R)	800(R)	1000(R)	
Voltages						
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 8)						
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V
		<	1880	1880	1880	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

APPLICATION INFORMATION

See general pages at the beginning of this section

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

OPERATING NOTES (See also general pages at the beginning of this section.)

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 that 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.

Determination of the heatsink thermal resistance.

Example:

Assume a diode, used in a three phase rectifier circuit.

frequency	f	= 50 Hz
average forward current	I_{FAV}	= 10 A (per diode)
ambient temperature	T_{amb}	= 40 °C
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	= 2 kW (per diode)
duration of P_{RRM}	t	= 40 μs

From the left hand part of the upper graph on page 5 it follows that at I_{FAV} = 10 A in a three phase rectifier circuit 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) W = 23.5 W (point B). In order to avoid excessive peak junction temperatures resulting from the pulse character of the repetitive peak reverse power in the avalanche region, the value of the maximum junction temperature should be reduced. 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 °C instead of 175 °C, thus 12 °C lower (see the lower graph on page 5).

Allowance can be made for this by assuming an ambient temperature 12 °C higher than before, in this case 52 °C instead of 40 °C.

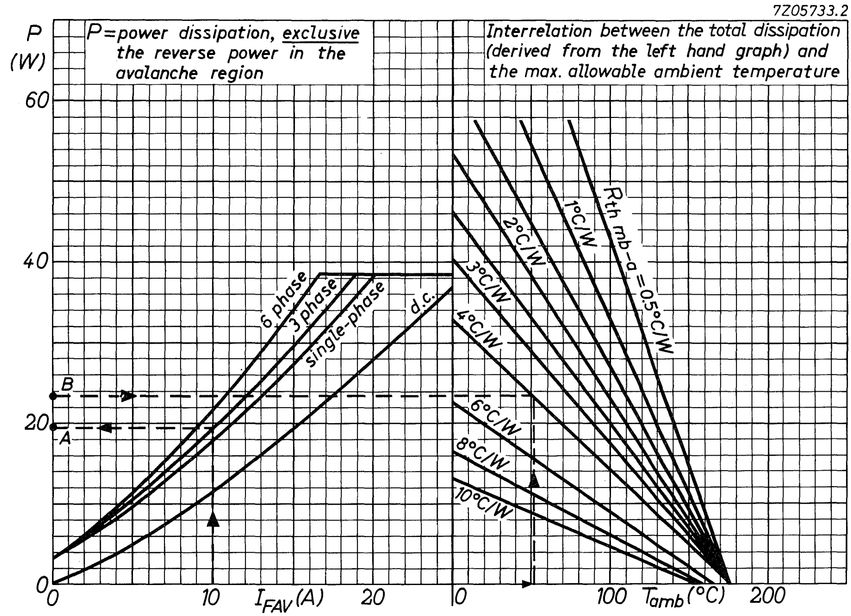
Using this in the curve leads to a thermal resistance

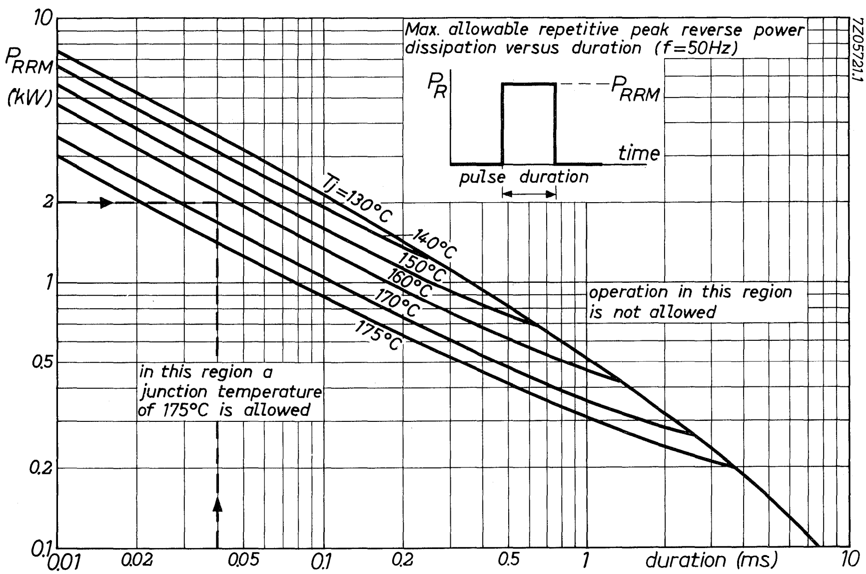
$$R_{th\ mb-a} \approx 4\ ^{o}C/W$$

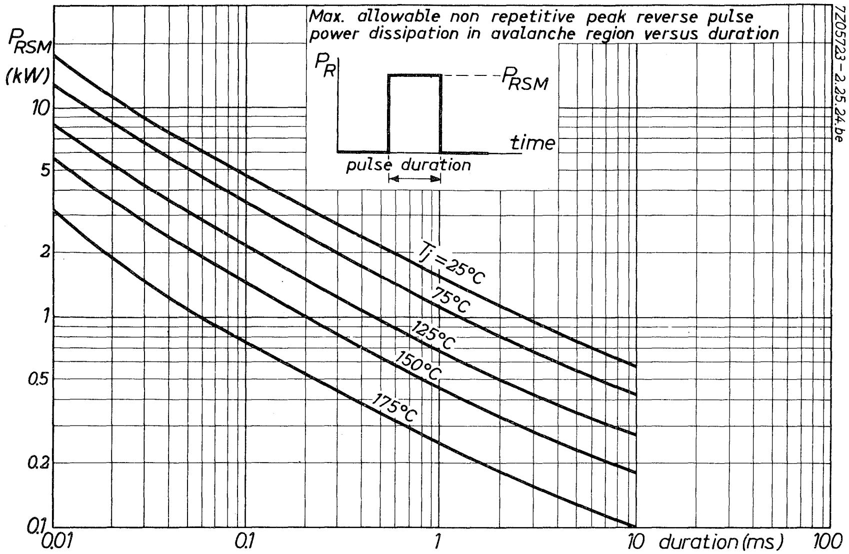
The contact thermal resistance $R_{th\ mb-h} = 0.5\ ^{o}C/W$
Hence the heatsink thermal resistance should be:

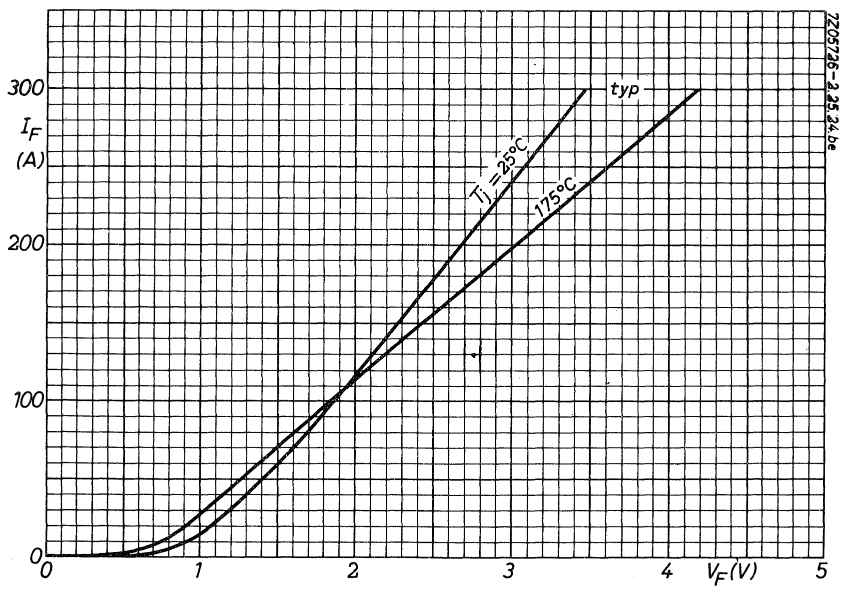
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (4 - 0.5)\ ^{o}C/W = 3.5\ ^{o}C/W$$

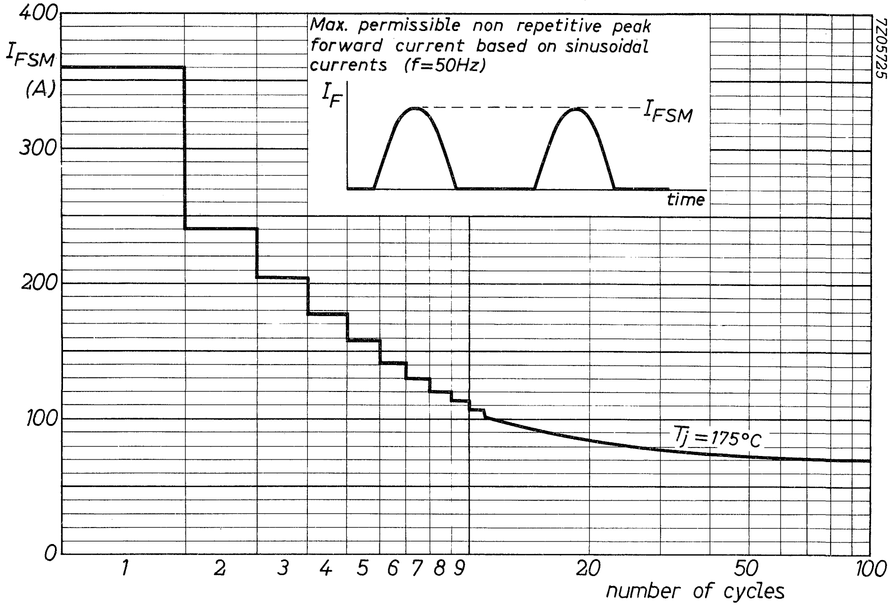
The applicable heatsink(s) may then be found in the Section HEATSINKS.

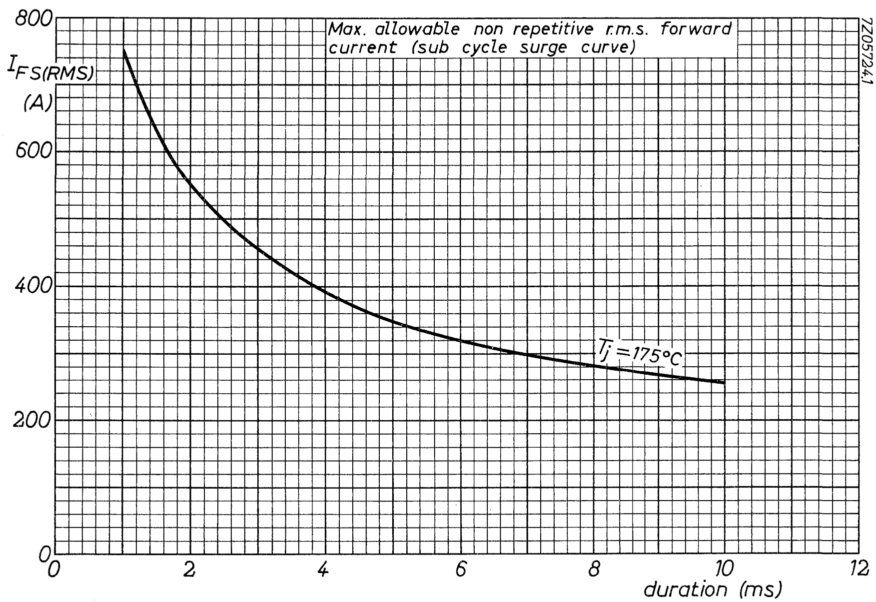

7Z05733.2
P (W)
P=power dissipation, exclusive the reverse power in the avalanche region
Interrelation between the total dissipation (derived from the left hand graph) and the max. allowable ambient temperature
6 phase
3 phase
single-phase
d.c.
B
A
Rth mb-a = 0.5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W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


7Z05721.1
P_{RRM} (kW)
Max. allowable repetitive peak reverse power dissipation versus duration (f=50Hz)
P_R
P_{RRM}
time
pulse duration
Tj=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 non repetitive peak reverse pulse power dissipation in avalanche region versus duration
P_R
P_{RSM}
time
pulse duration
P_{RSM} (kW)
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
$T_j = 25°C$
75°C
125°C
150°C
175°C
7Z05723-2.25.24.be


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


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


Max. allowable non repetitive r.m.s. forward current (sub cycle surge curve)
7Z05724.1
800
$I_{FS(RMS)}$
(A)
600
400
200
0
T_j =175°C
0
2
4
6
8
10
12
duration (ms)

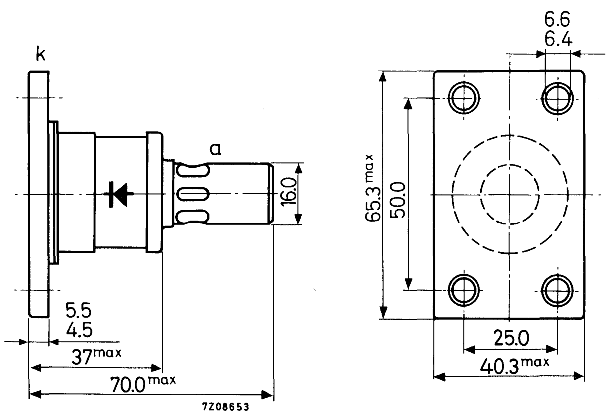
CONTROLLED AVALANCHE RECTIFIER DIODES

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

QUICK REFERENCE DATA

		BYX27 -	400	600	800	1000	
Crest working reverse voltage	V_{RWM} max.		400	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	500	750	1000	1250	V
		<	1600	1600	1600	1600	V
Average forward current up to $T_{mb} = 125\ ^{o}C$	$I_{F(AV)}$	max.		250			A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 190\ ^{o}C$ prior to surge	I_{FSM}	max.		4000			A
Non-repetitive peak reverse power dissipation ($t = 10\ \mu s$; $T_j = 25\ ^{o}C$)	P_{RSM}	max.		80			kW
Operating junction temperature	T_j	max.		190			^{o}C

MECHANICAL DATA Dimensions in mm



Net weight: 230 g
Accessories and mounting instructions: see page 3.

All information applies to frequencies up to 400 Hz.

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

Voltages [1]

			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) up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	250	A
→ Forward current (d. c.)	I_F	max.	400	A
R. M. S. forward current	$I_{F(RMS)}$	max.	400	A
Repetitive peak forward current	I_{FRM}	max.	1250	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 190 °C prior to surge	I_{FSM}	max.	4000	A
I squared t for fusing (t = 10 ms)	I^2t	max.	80000	A^2s

Reverse power dissipation

Average reverse power dissipation (averaged over any 20 ms period) T_j = 190 °C	$P_{R(AV)}$	max.	80	W
Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 190 °C	P_{RRM}	max.	20	kW
Non-repetitive peak reverse power dissipation; t = 10 µs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	80	kW
T_j = 190 °C prior to surge	P_{RSM}	max.	40	kW

Temperatures

Storage temperature	T_{stg}		−55 to +200	°C
Operating 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
with heatsink compound (e.g. Dow corning 340)	$R_{th\ mb\text{-}h}$	=	0.03	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.02	°C/W

[1]) To ensure thermal stability $R_{th\ j\text{-}a} \leq 0.7$ °C/W (continuous reverse voltage) or ≤ 1.3 °C/W (a.c.)

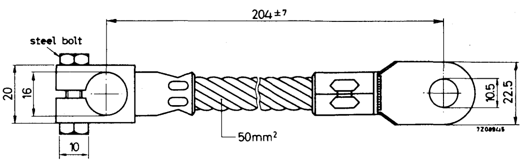
CHARACTERISTICS

			BYX27-400	600	800	1000	
Forward voltage I_F = 1250 A; T_j = 25 °C	V_F	<	1.7	1.7	1.7	1.7	V[1)]
Reverse avalanche breakdown voltage I_R = 25 mA; T_j = 25 °C	$V_{(BR)R}$	>	500	750	1000	1250	V
		<	1600	1600	1600	1600	V
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 175 °C	I_{RM}	<	50	42	32	25	mA

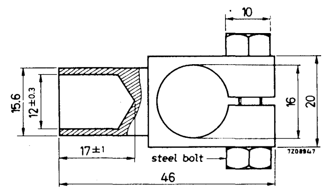
ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

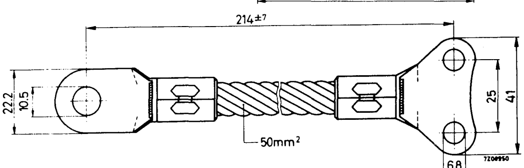
Flexible top lead
Type number 56243
Weight: 170 g



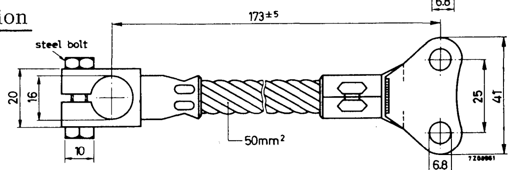
Clamp
Type number 56244
Weight: 70 g



Flexible base lead
Type number 56247
Weight: 135 g



Flexible top lead for series connection
Type number 56296
Weight: 155 g



1. These accessories are supplied 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 kg cm (3 Newton-metres); max. 60 kg cm (6 Newton-metres)
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact: 30 kgcm (3 Newton-metres)
   Max. torque : 60 kgcm (6 Newton-metres)

1) Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (See also general pages at the beginning of this section)

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 5. 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. ($n.E_D$)

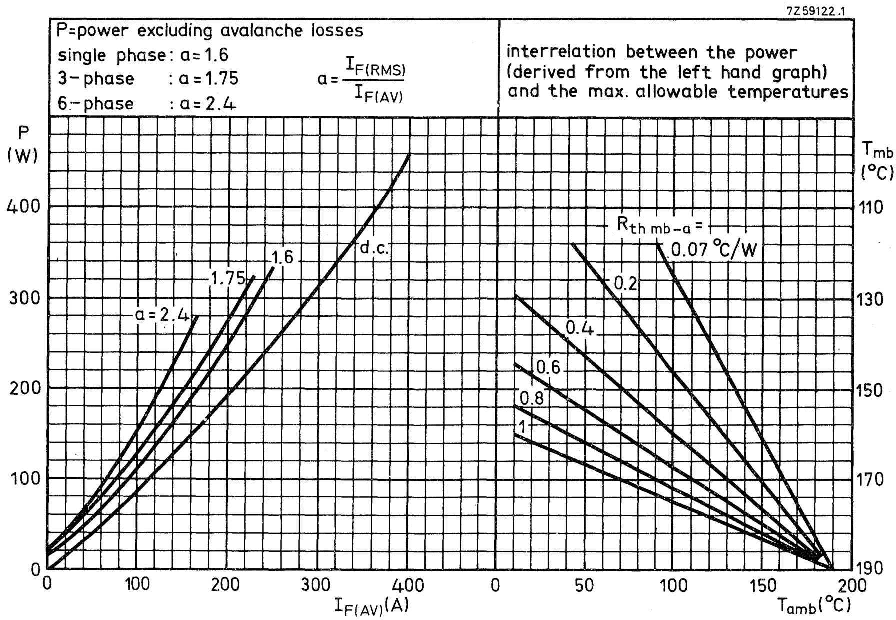
The difference between the energy released by the transformer and that absorbed by the n diodes should be absorbed by series connected R and C elements across the secondary winding of the transformer.
The magnitudes of R and C have to be derived from the following formulae:

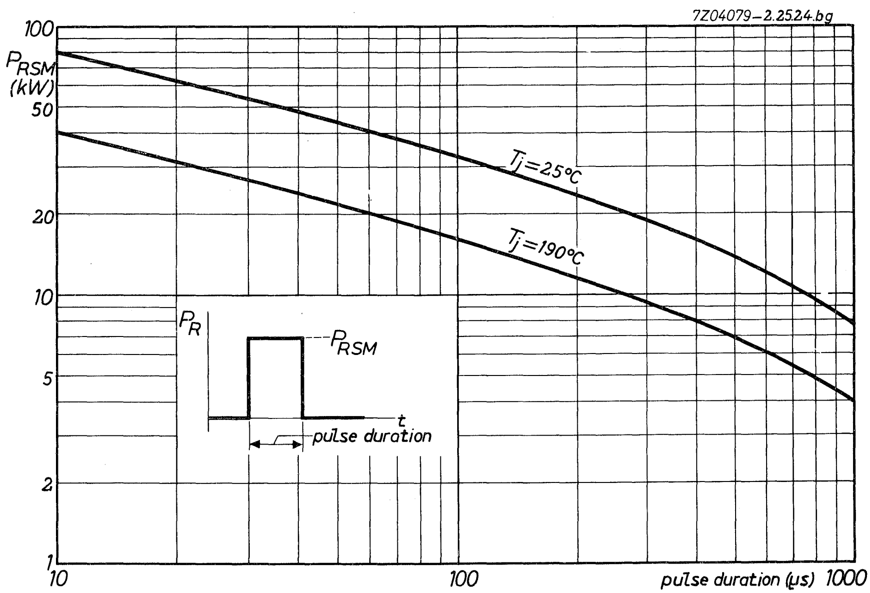
$$C = \frac{E_T - n.E_D}{(n.V_{(BR)R\,min})^2} \cdot 10^6 \quad (\mu F) \qquad R = \frac{310}{C} \quad (\Omega)$$

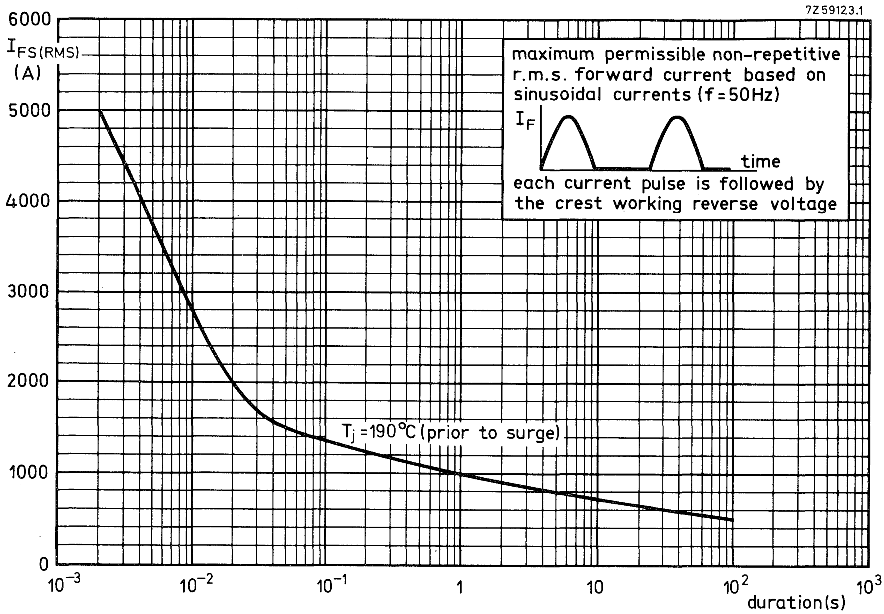
where C = capacitance in μF
E_T = energy released by the transformer in Ws
n = number of diodes in series
E_D = energy absorbed by one diode in Ws
$V_{(BR)R\,min}$ = minimum reverse breakdown voltage of one diode in V
R = resistance in Ω

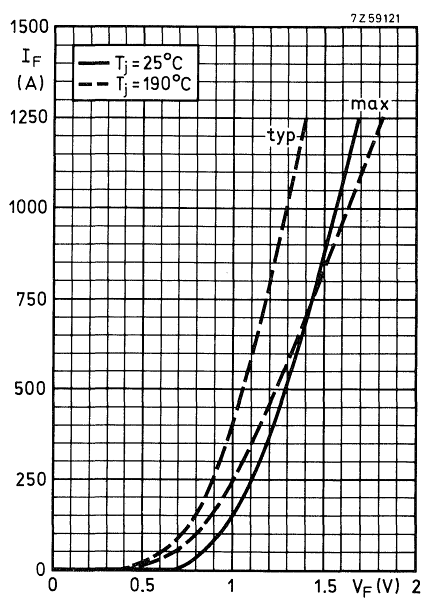
APPLICATION INFORMATION

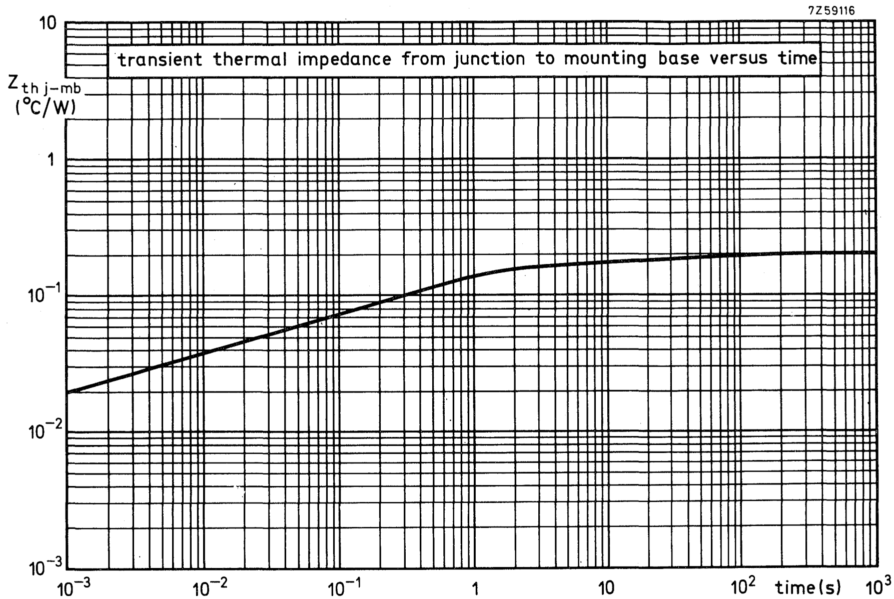
See general pages at the beginning of this section.


7Z59122.1
P=power excluding avalanche losses
single phase: a = 1.6
3-phase : a = 1.75
6-phase : a = 2.4
a = I_F(RMS) / I_F(AV)
interrelation between the power
(derived from the left hand graph)
and the max. allowable temperatures
P
(W)
400
300
200
100
0
0
100
200
300
400
I_F(AV) (A)
a = 2.4
1.75
1.6
d.c.
Tmb
(°C)
110
130
150
170
190
R_th mb-a =
0.07 °C/W
0.2
0.4
0.6
0.8
1
0
50
100
150
200
Tamb (°C)


7Z04079-2.25.24.bg
100
P_RSM
(kW)
50
20
10
5
2
1
10
100
1000
pulse duration (μs)
Tj=25°C
Tj=190°C
P_R
P_RSM
t
pulse duration


7Z59123.1
$I_{FS(RMS)}$
(A)
6000
5000
4000
3000
2000
1000
0
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
10^{3}
duration(s)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 190°C (prior to surge)


7Z59121
I_F
(A)
1500
1250
1000
750
500
250
0
0.5
1
1.5
V_F (V)
2
T_j = 25°C
T_j = 190°C
max
typ


7Z59116
transient thermal impedance from junction to mounting base versus time
$Z_{th\ j-mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
time (s)
10^{3}

CONTROLLED AVALANCHE HIGH VOLTAGE DIODES

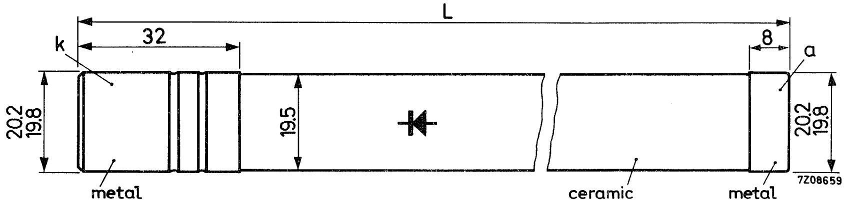
Silicon diodes in a ceramic envelope with metal connectors capable of absorbing transients and primarily intended for high voltage rectifier circuits in X-ray applications.
The series consists of the following types:
BYX29-75000, BYX29-100000, BYX29-125000 and BYX29-150000.

QUICK REFERENCE DATA

			BYX29-75000	100000	125000	150000	
Crest working reverse voltage	V_{RWM}	max.	75	100	125	150	kV
Average forward current	I_{FAV}	max.	50	50	50	50	mA
Non repetitive peak forward current; t = 10 ms	I_{FSM}	max.	5000	5000	5000	5000	mA
Junction temperature	T_j	max.	125	125	125	125	^oC
Thermal resistance from junction to cooling oil	$R_{th\ j-o}$	=	3.2	2.7	1.6	1.6	$^oC/W$

MECHANICAL DATA

Dimensions in mm



BYX29- 75000	L : 141 to 143 mm	Weight: 135 g
BYX29-100000	L : 169 to 171 mm	Weight: 165 g
BYX29-125000	L : 229 to 231 mm	Weight: 225 g
BYX29-150000	L : 229 to 231 mm	Weight: 225 g

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1])

Voltages

		BYX29-75000	100000	125000	150000	
Crest working reverse voltage	V_{RWM}	max. 75	100	125	150	kV

Currents

Average forward current
(averaged over any 20 ms period)

continuous operation	I_{FAV}	max.	50	mA
intermittent operation ($t \leq 1$ s, once every 20 s)	I_{FAV}	max.	750	mA

Repetitive peak forward current

continuous operation	I_{FRM}	max.	250	mA
intermittent operation (at an average forward current I_{FAV} = 750 mA; $t \leq 1$ s, once every 20 s)	I_{FRM}	max.	2500	mA
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.	5000	mA

Non repetitive peak reverse current

$t < 10\ \mu s$; T_j = 25 °C	I_{RSM}	max.	500	mA
T_j = 125 °C	I_{RSM}	max.	400	mA

Temperatures

Storage temperature	T_{stg}		−30 to +125	°C
Junction temperature	T_j	max.	125	°C

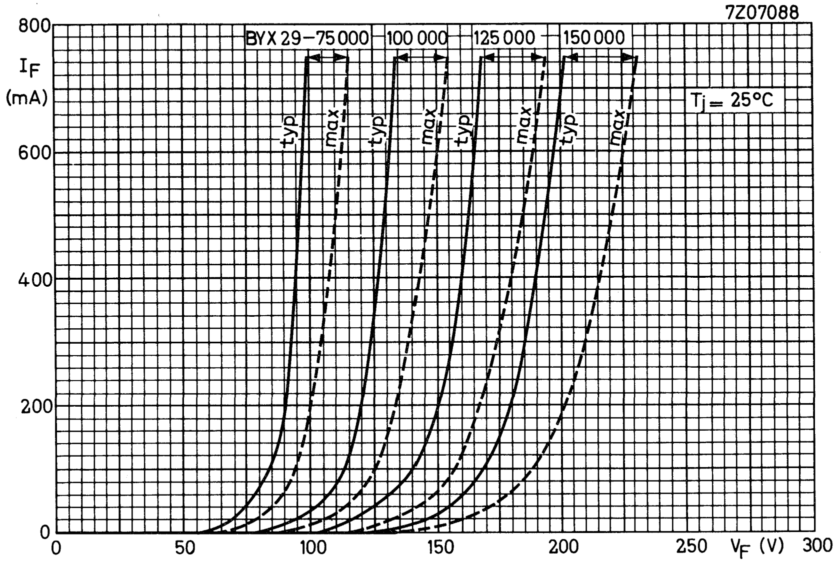
THERMAL RESISTANCE

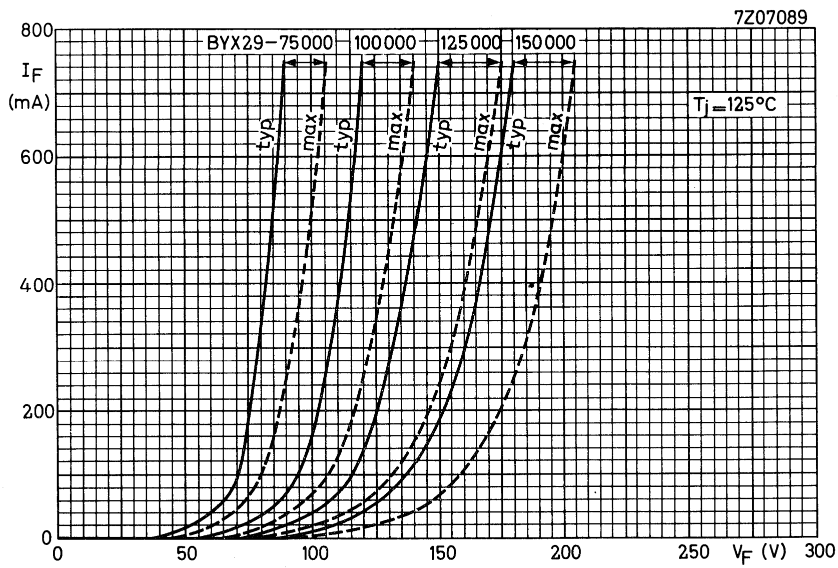
		BYX29-75000	100000	125000	150000	
From junction to cooling oil	$R_{th\ j\text{-}o}$ =	3.2	2.7	1.6	1.6	°C/W

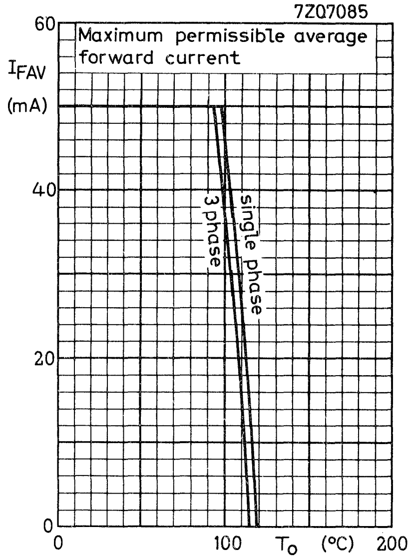
CHARACTERISTICS

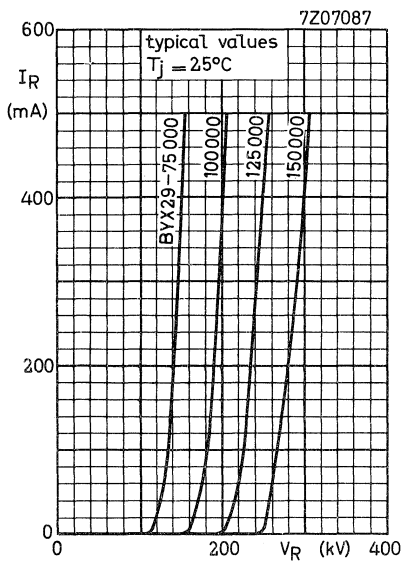
		BYX29-75000	100000	125000	150000	
Voltages at T_j = 25 °C						
Forward voltage at I_F = 50 mA	V_F	< 88	116	145	175	V
Reverse breakdown voltage I_R = 1 mA	$V_{(BR)R}$	> 100	135	165	200	kV
Currents at T_j = 125 °C						
Reverse current at $V_R = V_{RWMmax}$	I_R	< 33	33	33	33	μA

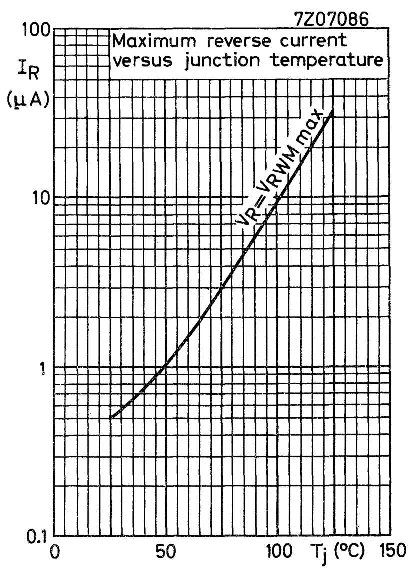
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.


7Z07088
800
I_F
(mA)
600
400
200
0
0
50
100
150
200
250
V_F (V)
300
BYX 29−75 000
100 000
125 000
150 000
typ
max
T_j = 25°C


7Z07089
800
I_F
(mA)
600
400
200
0
0
50
100
150
200
250
V_F (V)
300
BYX29−75000
100000
125000
150000
typ
max
T_j =125°C


7Z07085
Maximum permissible average forward current
I_{FAV} (mA)
60
40
20
0
3 phase
single phase
0
100
T_o (°C)
200


7Z07087
typical values
$T_j = 25$°C
I_R (mA)
600
400
200
0
BYX29-75000
100000
125000
150000
0
200
V_R (kV)
400


7Z07086
Maximum reverse current versus junction temperature
I_R (μA)
100
10
1
0.1
$V_R = V_{RWM}$ max
0
50
100
T_j (°C)
150

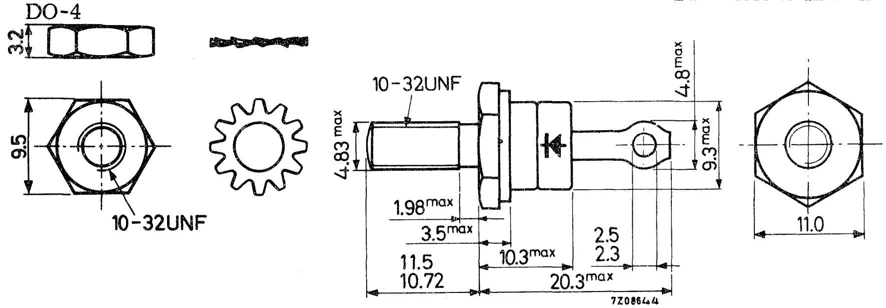
FAST RECOVERY RECTIFIER DIODES WITH CONTROLLED AVALANCHE

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 (cathode to stud): BYX30-200 to BYX30-600.
Reverse polarity (anode to stud) : BYX30-200R to BYX30-600R.

QUICK REFERENCE DATA

			BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Average forward current at T_{mb} = 100 °C	I_{FAV}	max.					14	A
T_{mb} = 125 °C	I_{FAV}	max.					7.5	A
Non repetitive peak forward current; t = 10 ms	I_{FSM}	max.					250	A
Repetitive peak reverse power t = 10 μs; T_j = 150 °C	P_{RRM}	max.					5.5	kW
Non repetitive peak reverse power; t = 10 μs; T_j = 25 °C	P_{RSM}	max.					18	kW
Junction temperature	T_j	max.					150	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=					1.3	°C/W
Recovered charge $I_F = I_R$ = 2 A	Q_s	<					0.70	μC

MECHANICAL DATA Dimensions in mm
DO-4



Net weight : 5.6 g
With accessories: 7.6 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295, (56262A)

Torque on nut: min. 8 cm kg
max. 17 cm kg
The mark shown applies to normal polarity types.

All information applies to frequencies up to 50 kHz

RATINGS (Limiting values) [1])

Voltages [2])

			BYX30-200(R)	300(R)	400(R)	500(R)	600(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

Currents

Average forward current (averaged over any 20 ms period) at $T_{mb} = 100\ ^oC$	I_{FAV}	max.	14	A
$T_{mb} = 125\ ^oC$	I_{FAV}	max.	7.5	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 (see also page 7)	I_{FSM}	max.	250	A
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

Reverse power dissipation

Repetitive peak reverse power at f = 50 Hz square wave; t = 10 μs; $T_j = 150\ ^oC$	P_{RRM}	max.	5.5	kW
Non repetitive peak reverse power (square wave) See also page 6 t = 10 μs; $T_j = 25\ ^oC$	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]) To ensure thermal stability: $R_{th\ j-a} < 2.5\ ^oC/W$ (d.c.) or $< 5\ ^oC/W$ (a.c.) For smaller heatsinks $T_{j\,max.}$ should be derated. For a.c. see page 5.
For d.c.: if $R_{th\ j-a} = 5\ ^oC/W$, then $T_{j\,max.} = 135\ ^oC$,
if $R_{th\ j-a} = 10\ ^oC/W$, then $T_{j\,max.} = 120\ ^oC$.

CHARACTERISTICS

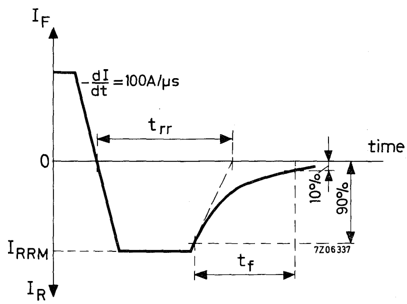
T_j = 25 °C unless otherwise specified

		BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Forward voltage at I_F = 50 A [1]	V_F	< 3.2	3.2	3.2	3.2	3.2	V
Reverse breakdown voltage I_R = 5 mA; see page 8	$V_{(BR)R}$	> 250	375	500	625	750	V
		< 1050	1050	1050	1050	1050	V
Reverse current at T_j = 125 °C $V_R = V_{RWMmax}$.	I_R	< 4.0	4.0	4.0	4.0	4.0	mA

Recovered charge when switched from
I_F = 2 A to V_R = 30 V;
I_R limited to I_{RRM} = 2 A; $-\frac{dI}{dt}$ = 100 A/μs $\qquad Q_s \quad < 0.70 \quad \mu C$

Reverse recovery time when switched from
I_F = 2 A to V_R = 30 V;
I_R limited to I_{RRM} = 2 A; $-\frac{dI}{dt}$ = 100 A/μs $\qquad t_{rr} \quad < 0.35 \quad \mu s$

Fall time under all conditions $\qquad t_f \quad < 0.30 \quad \mu s$



OPERATING NOTES (See also general pages at the beginning of this section.)

1. Square wave operation
   When I_F has been flowing sufficiently long for the steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during t_f as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graphs on page 10.

p.t.o.

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

OPERATING NOTES (continued)

2. Sine wave operation

Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of I_{RRM}), so that power loss due to reverse recovery may be safely ignored for frequencies up to 20 kHz.

3. Determination of the heatsink thermal resistance

Example:
Assume a diode, used in an inverter.

frequency	f	=	20	kHz
duty cycle	δ	=	0.5	
ambient temperature	T_{amb}	=	45	^oC
switched from	I_F	=	12	A
to	V_R	=	400	V
at a rate	$-\frac{dI}{dt}$	=	20	A/μs

At a duty cycle δ = 0.5 the average forward current I_{FAV} = 6 A.
From the upper graph on page 5 it follows, that at I_{FAV} = 6 A the average forward power + average leakage power = 15 W (point A).
The additional power losses due to switching-off can be read from the nomogram on page 10 (the example being based on optimum use, i.e. T_j = 150 ^oC). Starting from I_F = 12 A on the horizontal scale trace upwards until the appropriate line $-\frac{dI}{dt}$ = 20 A/μs. From the intersection trace horizontally to the right until the line for f = 20 kHz. Then trace downwards to the line V_R = 400 V and ultimately trace horizontally to the left and on the vertical axis read the additional average power dissipation P_{RAV} = 4 W.
Therefore the total power dissipation P_{tot} = 15 W + 4 W = 19 W (point B of the upper graph on page 5). From the right hand part follows the thermal resistance, required at T_{amb} = 45 ^oC.

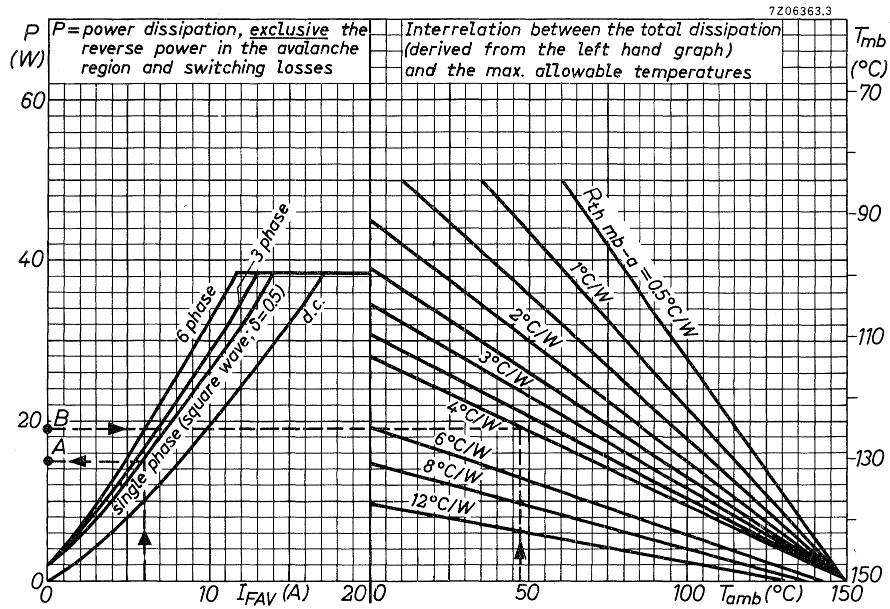
$$R_{th\ mb\text{-}a} \approx 4\ ^oC/W$$

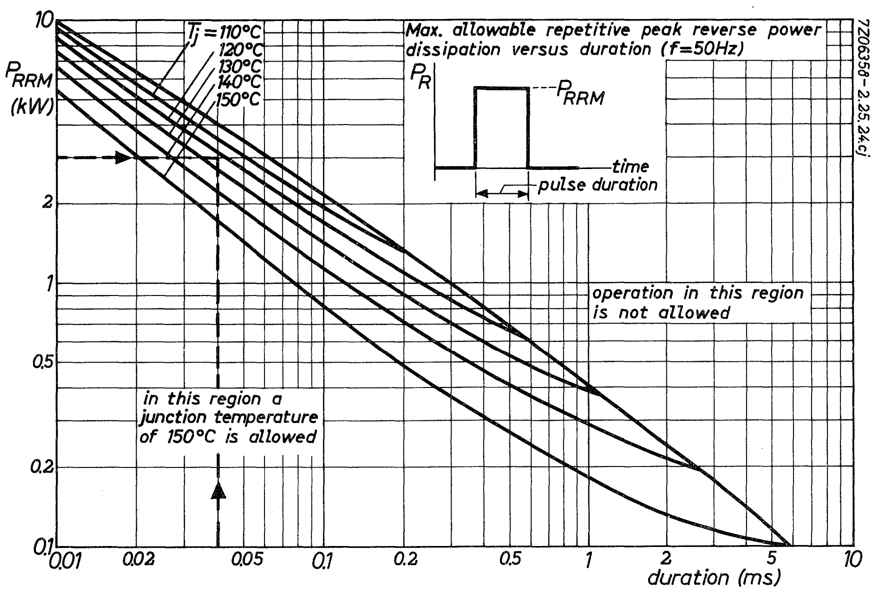
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.5 ^oC/W.

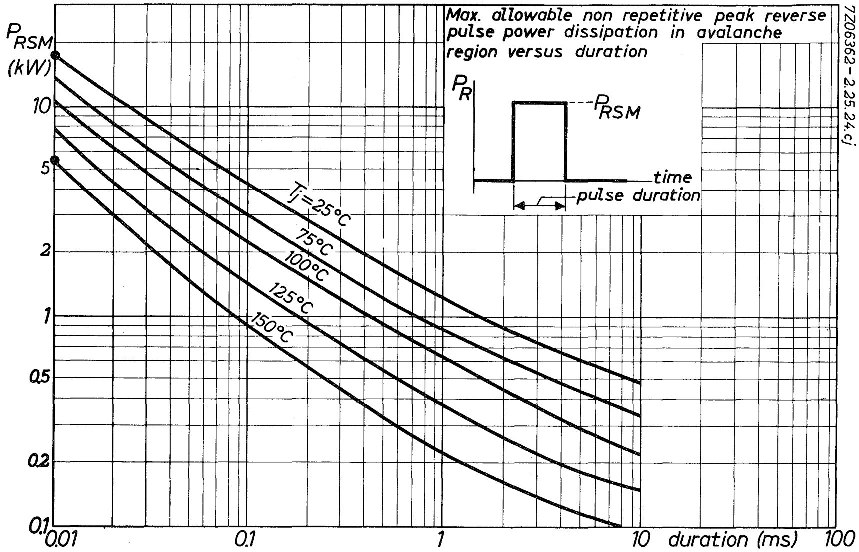
Hence the heatsink thermal resistance should be:

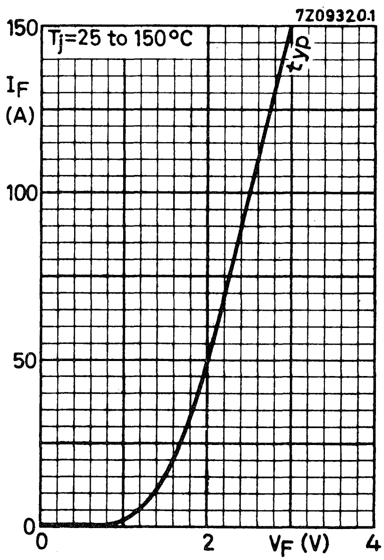
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (4 - 0.5)\ ^oC/W = 3.5\ ^oC/W.$$

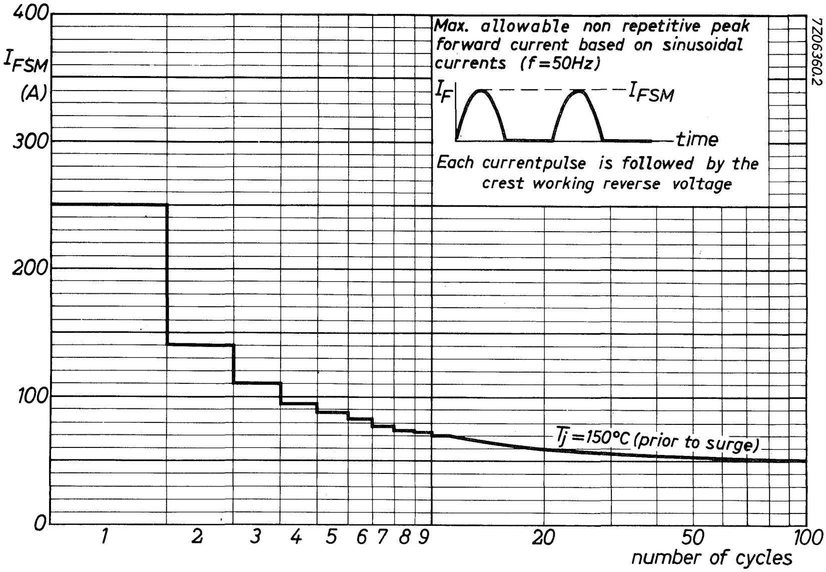
The applicable heatsink(s) may then be found in the Section HEATSINKS.

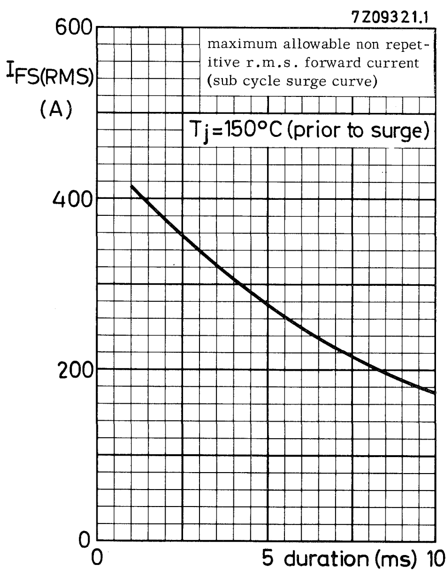

7Z06363.3
P (W)
P = power dissipation, exclusive the reverse power in the avalanche region and switching losses
Interrelation between the total dissipation (derived from the left hand graph) and the max. allowable temperatures
T_{mb} (°C)
6 phase
3 phase
single phase (square wave; δ=0.5)
d.c.
B
A
$R_{th\ mb-a}$ = 0.5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W
12°C/W
I_{FAV} (A)
T_{amb} (°C)

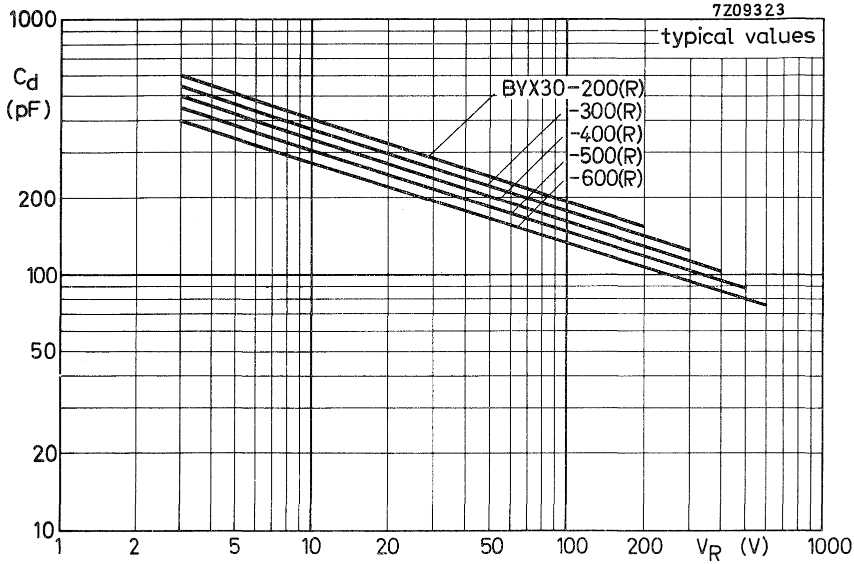

P_{RRM} (kW)
T_j = 110°C
120°C
130°C
140°C
150°C
Max. allowable repetitive peak reverse power dissipation versus duration (f=50Hz)
P_R
P_{RRM}
time
pulse duration
operation in this region is not allowed
in this region a junction temperature of 150°C is allowed
duration (ms)
7Z06358-2.25.24.ci

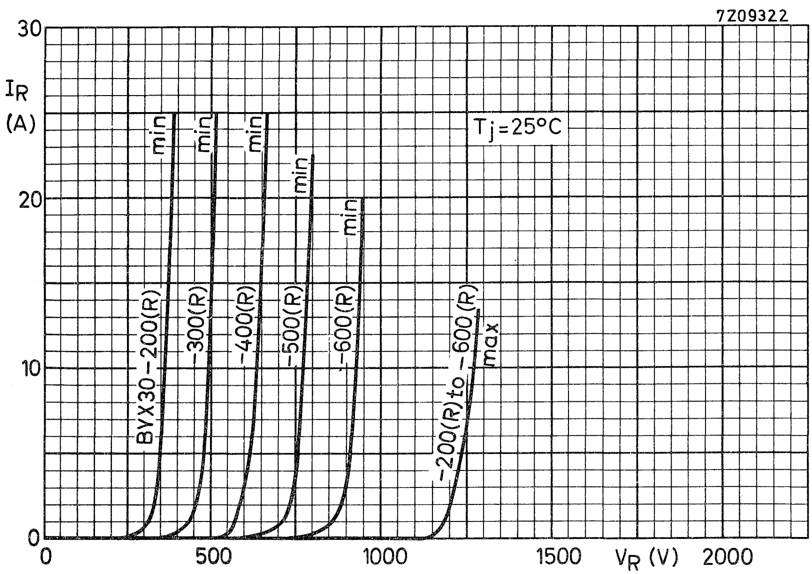

Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration
7Z06362-2.25.24.cj
P_{RSM} (kW)
P_R
P_{RSM}
time
pulse duration
T_j=25°C
75°C
100°C
125°C
150°C
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100

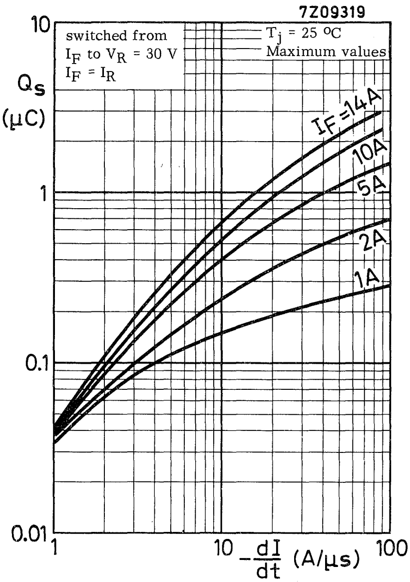

7Z09320.1
T_j=25 to 150°C
typ
I_F (A)
150
100
50
0
0
2
V_F (V)
4

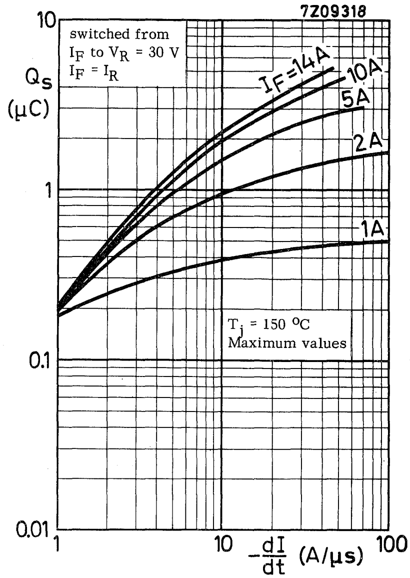

400
I_{FSM}
(A)
300
200
100
0
Max. allowable non repetitive peak forward current based on sinusoidal currents (f=50Hz)
I_F
I_{FSM}
time
Each currentpulse is followed by the crest working reverse voltage
T_j=150°C (prior to surge)
1 2 3 4 5 6 7 8 9 20 50 100
number of cycles
7Z06360.2

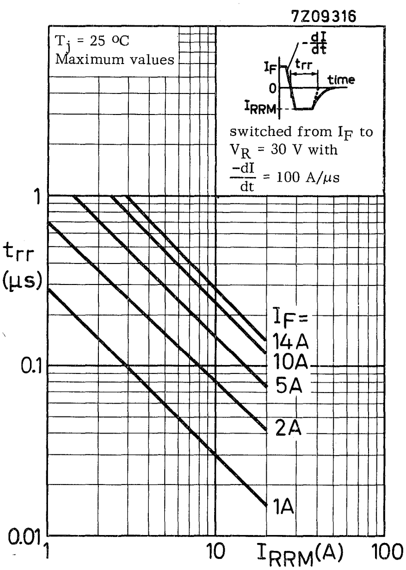

7Z09321.1
600
$I_{FS(RMS)}$
(A)
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
T_j=150°C (prior to surge)
400
200
0
0
5 duration (ms) 10

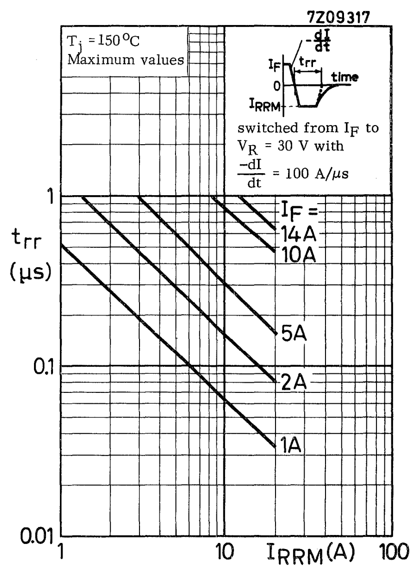

7Z09323
typical values
1000
C_d
(pF)
200
100
50
20
10
BYX30-200(R)
-300(R)
-400(R)
-500(R)
-600(R)
1
2
5
10
20
50
100
200
V_R (V)
1000

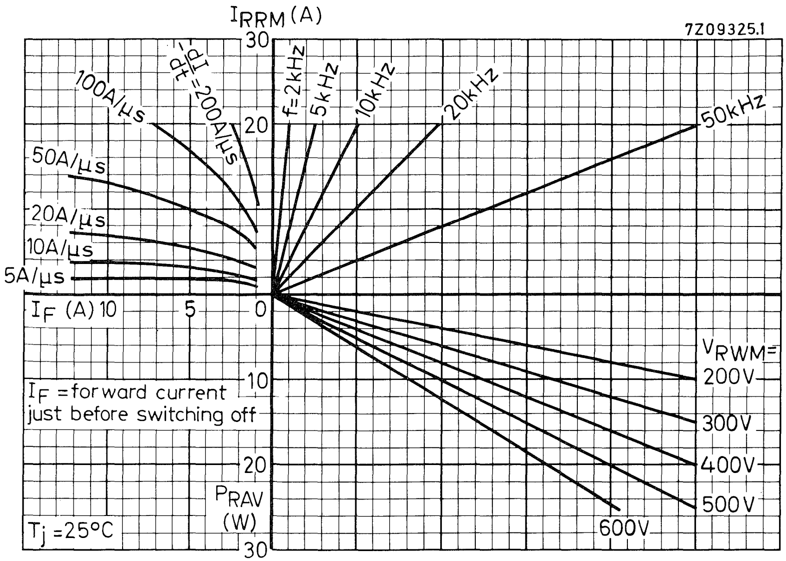

7Z09322
30
I_R
(A)
20
10
0
T_j=25°C
min
min
min
min
min
BYX30-200(R)
-300(R)
-400(R)
-500(R)
-600(R)
-200(R) to -600(R)
max
0
500
1000
1500
V_R (V)
2000

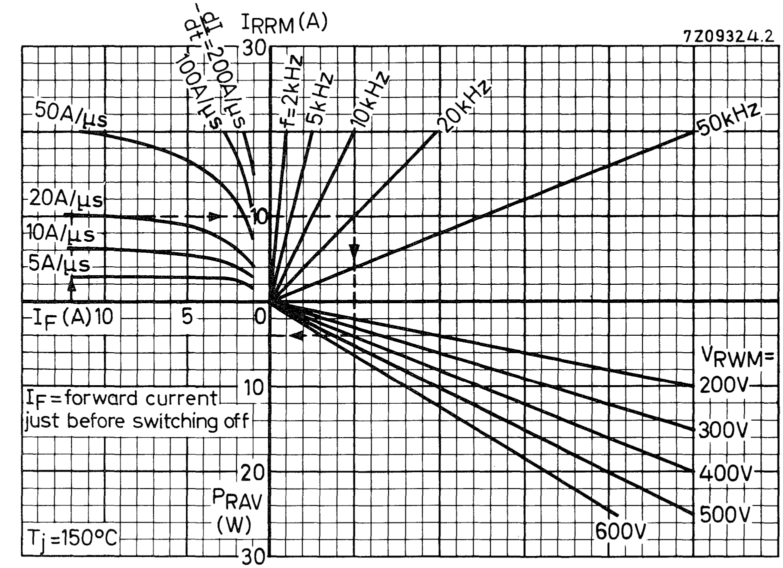

7Z09319
switched from
I_F to V_R = 30 V
$I_F = I_R$
T_j = 25 °C
Maximum values
Q_s (μC)
I_F =14A
10A
5A
2A
1A
$-\frac{dI}{dt}$ (A/μs)


7Z09318
switched from
I_F to V_R = 30 V
$I_F = I_R$
T_j = 150 °C
Maximum values
Q_s (μC)
I_F =14A
10A
5A
2A
1A
$-\frac{dI}{dt}$ (A/μs)


7Z09316
T_j = 25 °C
Maximum values
switched from I_F to V_R = 30 V with $\frac{-dI}{dt}$ = 100 A/μs
t_{rr} (μs)
I_F =
14A
10A
5A
2A
1A
I_{RRM}(A)


7Z09317
T_j =150 °C
Maximum values
switched from I_F to V_R = 30 V with $\frac{-dI}{dt}$ = 100 A/μs
t_{rr} (μs)
I_F =
14A
10A
5A
2A
1A
I_{RRM}(A)





Nomogram: Power loss P_{RAV} due to switching only (square wave operation)

SILICON RECTIFIER DIODES

Diffused silicon diodes in metal envelopes with ceramic insulation, intended for power rectifier application. The series consists of the following types:
Normal polarity (cathode to stud): BYX32-400 to BYX32-1600
Reverse polarity (anode to stud): BYX32-400R to BYX32-1600R

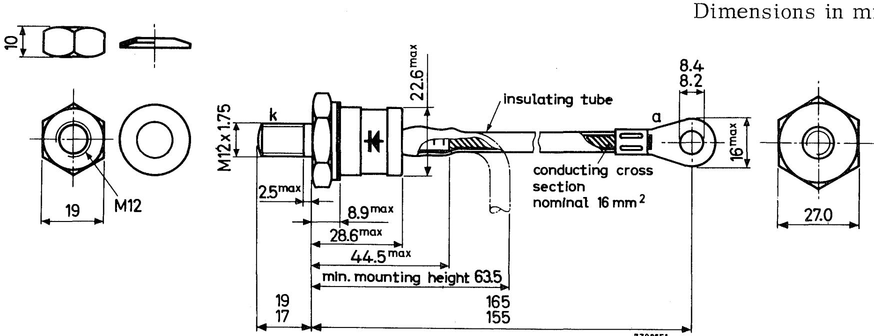
QUICK REFERENCE DATA

		BYX32-	400 400R	600 600R	800 800R	1000 1000R	1200 1200R	1600 1600R
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	1200	1200 V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	1600 V

Average forward current up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	150	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	115	A
Non-repetitive peak forward current t = 10 ms; T_j = 190 °C prior to surge	I_{FSM}	max.	1600	A
Operating junction temperature	T_j	max.	190	°C

MECHANICAL DATA

Dimensions in mm



Normal polarity (cathode-stud symbol): blue cable. Reverse polarity (anode-stud symbol): red cable.

Net weight : 115 g

Diameter of clearance hole: max. 13.0 mm

Torque on nut: min. 100 kg cm
(10 Newton-metres)
max. 250 kg cm
(25 Newton-metres)

All information applies to frequencies up to 400 Hz.

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

Voltages 1)		BYX32-	400 400R	600 600R	800 800R	1000 1000R	1200 1200R	1600 1600R	
Continuous reverse voltage	V_R	max.	400	600	800	1000	1200	1200	V
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	1600	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	450	650	900	1100	1300	1600	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	150 A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	115 A
Forward current (d.c.)	I_F	max.	240 A
R.M.S. forward current	$I_{F(RMS)}$	max.	240 A
Repetitive peak forward current	I_{FRM}	max.	750 A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 190 °C prior to surge	I_{FSM}	max.	1600 A
I squared t for fusing (t = 10 ms)	I^2t	max.	12800 A^2s

Temperatures

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

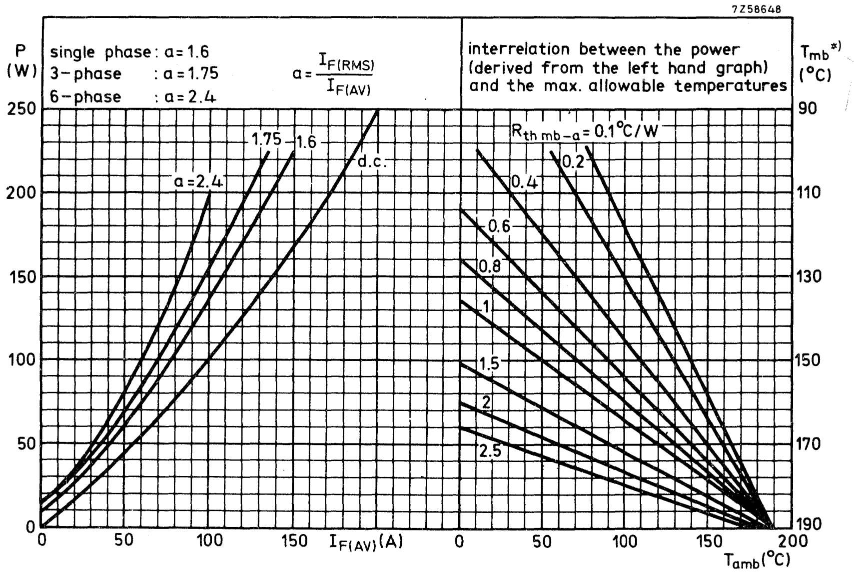
THERMAL RESISTANCE

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
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.025 °C/W

1) To ensure thermal stability: $R_{th\ j\text{-}a}$ < 0.75 °C/W (continuous reverse voltage) or < 1.5 °C/W (a.c.)
For smaller heatsinks T_j should be derated. For a.c. see graph on page 3.
For continuous reverse voltage: $R_{th\ j\text{-}a}$ = 1 °C/W, then T_{jmax} = 184 °C
$R_{th\ j\text{-}a}$ = 1.2 °C/W, then T_{jmax} = 180 °C
$R_{th\ j\text{-}a}$ = 1.5 °C/W, then T_{jmax} = 175 °C

CHARACTERISTICS

		BYX32 – 400(R)	600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Forward voltage $I_F = 500\,A$; $T_j = 25\,^oC$	V_F <	1.6	1.6	1.6	1.6	1.6	1.6	V [1]
Peak reverse current $V_{RM} = V_{RWM\,max}$ $T_j = 175\,^oC$	I_{RM} <	30	24	18	15	12	12	mA

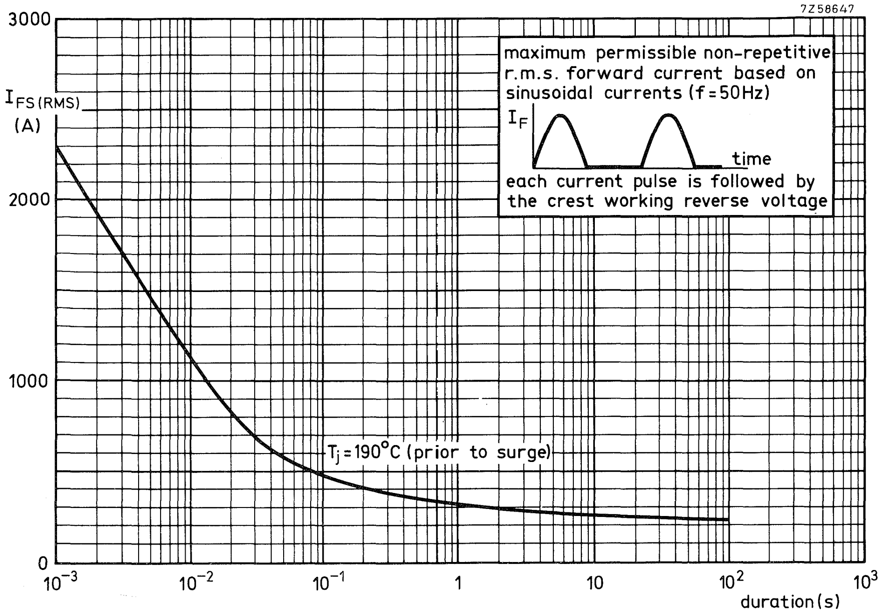


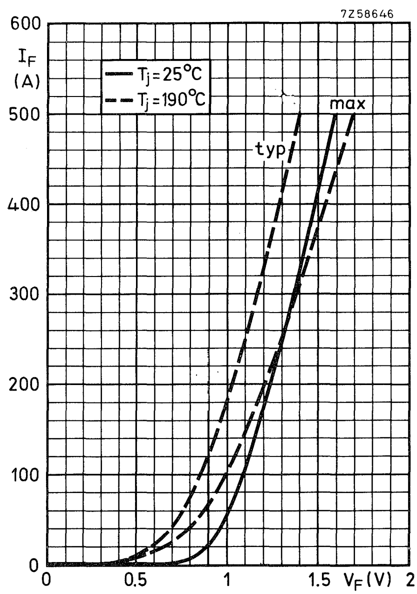
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\,mb-a} \leq 1.1\,^oC/W$

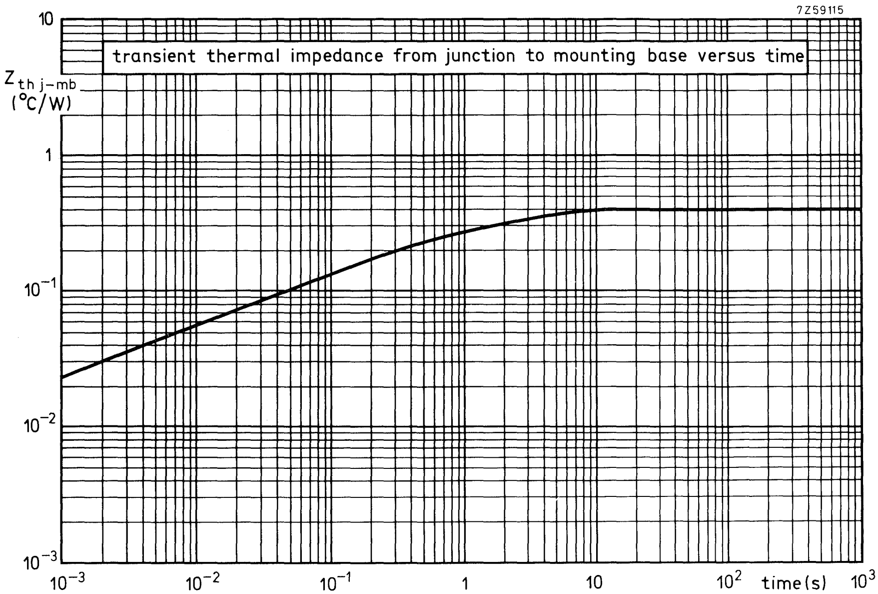
APPLICATION INFORMATION AND OPERATING NOTES

See general pages at the beginning of this section.

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


7Z58647
3000
2000
1000
0
$I_{FS(RMS)}$
(A)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 190°C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
duration (s)


7Z58646
600
500
400
300
200
100
0
I_F
(A)
T_j = 25°C
T_j = 190°C
typ
max
0
0.5
1
1.5
V_F (V)
2


7Z59115
transient thermal impedance from junction to mounting base versus time
$Z_{th\ j-mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
time(s)
10^{3}

SILICON RECTIFIER DIODES

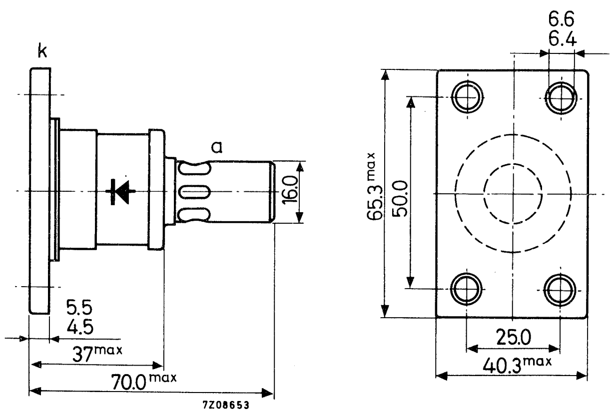
Diffused silicon diodes in metal envelopes with ceramic insulation, intended for power rectifier application. The series consists of the following types:
Normal polarity (cathode to stud): BYX33-400 to 1600
Reverse polarity (anode to stud) : BYX33-400R to 1600R

QUICK REFERENCE DATA

		BYX33-400(R)	600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Crest working reverse voltage	V_{RWM} max.	400	600	800	1000	1200	1200	V
Repetitive peak reverse voltage	V_{RRM} max.	400	600	800	1000	1200	1600	V

Average forward current up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	250	A
water cooled up to T_{mb} = 55 °C	$I_{F(AV)}$	max.	400	A
Non-repetitive peak forward current t = 10 ms; T_j = 190 °C prior to surge	I_{FSM}	max.	4000	A
Operating junction temperature	T_j	max.	190	°C

MECHANICAL DATA Dimensions in mm



Net weight: 230 g
Normal polarity (cathode to stud,): blue circle on top.
Reverse polarity (anode to stud,): red circle on top.
Accessories and mounting instructions: see page 3.

All information applies to frequencies up to 400 Hz.

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

Voltages [1]			BYX33-400(R)	600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Continuous reverse voltage	V_R	max.	400	600	800	1000	1200	1200	V
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	1600	V
Non-repetitive peak reverse voltage ($t \leq$ 10 ms)	V_{RSM}	max.	450	650	900	1100	1300	1600	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	250	A
water cooled up to T_{mb} = 55 °C	$I_{F(AV)}$	max.	400	A
→ Forward current (d.c.)	I_F	max.	625	A
R.M.S. forward current	$I_{F(RMS)}$	max.	625	A
Repetitive peak forward current	I_{FRM}	max.	2000	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 190 °C prior to surge	I_{FSM}	max.	4000	A
I squared t for fusing (t = 10 ms)	I^2t	max.	80000	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to +200 °C
Operating 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
with heatsink compound (e.g. Dow Corning 340)	$R_{th\ mb\text{-}h}$ =	0.03	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$ =	0.02	°C/W

[1] To ensure thermal stability $R_{th\ j\text{-}a} \leq 0.7$ °C/W (continuous reverse voltage) or ≤ 1.3 °C/W (a.c.)

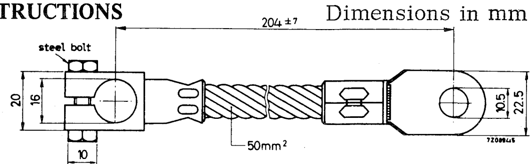
CHARACTERISTICS

		BYX33-400(R)	600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Forward voltage $I_F = 1250$ A; $T_j = 25$ °C	V_F <	1.7	1.7	1.7	1.7	1.7	1.7	V [1]
Peak reverse current $V_{RM} = V_{RWM}$; $T_j = 175$ °C	I_{RM} <	50	42	32	25	20	20	mA

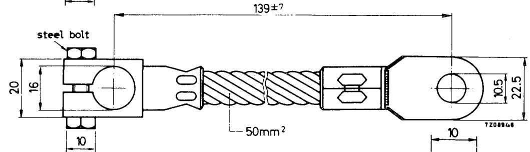
ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

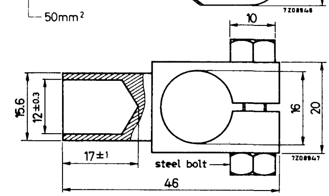
Flexible top lead
Type number 56243
Weight: 170 g



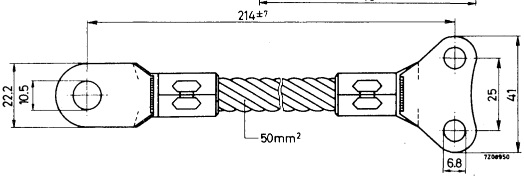
Flexible top lead
Type number 56243A
Weight: 140 g



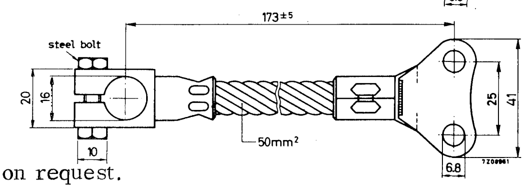
Clamp
Type number 56244
Weight: 70 g



Flexible base lead
Type number 56247
Weight: 135 g



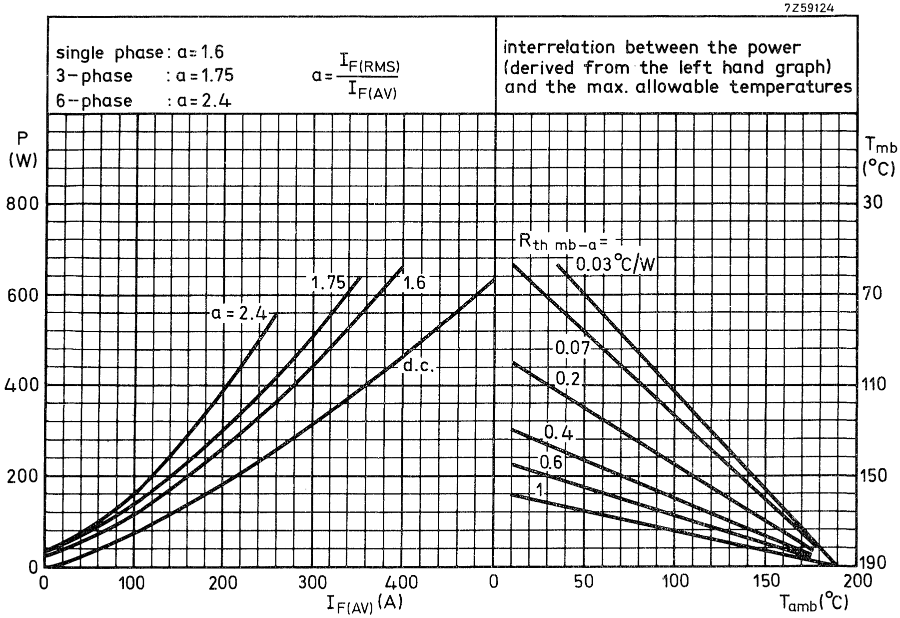
Flexible top lead for series connection
Type number 56296
Weight: 155 g



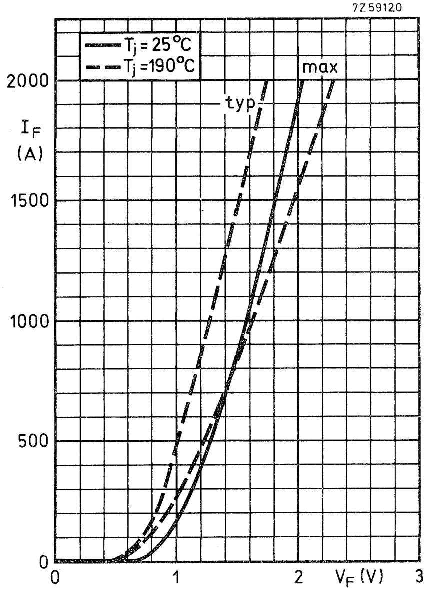
1. These accessories are supplied on request.
2. For mounting of the flexible top lead it is recommended to use two spanners to avoid damage.
   Torque on nut: min. 30 kg cm (3 Newton-metres); max. 60 kg cm (6 Newton-metres)
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact: 30 kg cm (3 Newton-metres)
   Max. torque : 60 kg cm (6 Newton-metres)
4. Top lead 56243 should only be used for $I_{F(RMS)} \leq 400$ A
   Top lead 56243 is necessary for $I_{F(RMS)} > 400$ A to prevent excessive temperature of the top connection.

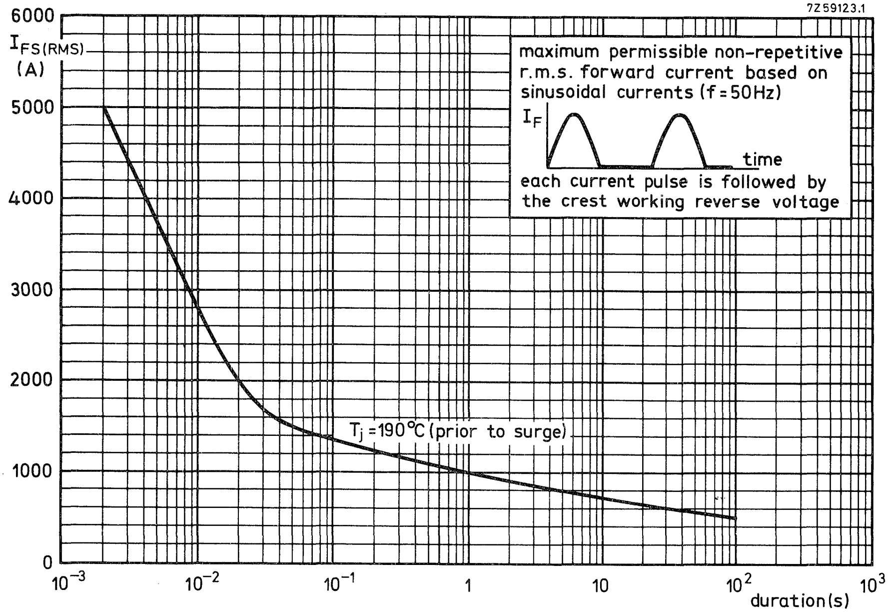
[1] Measured under pulsed conditions to avoid excessive dissipation.

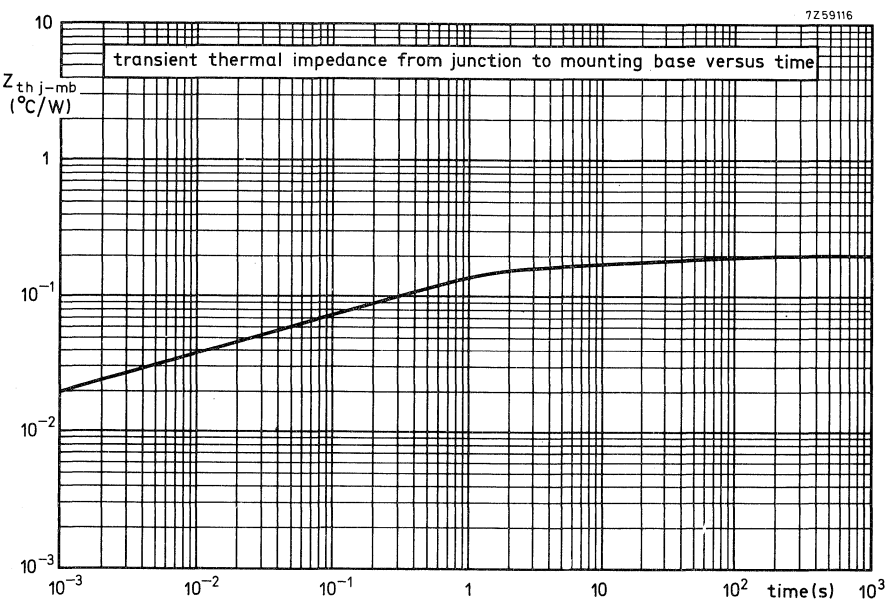
7Z59124



7Z59120




7Z59123.1
6000
$I_{FS(RMS)}$
(A)
5000
4000
3000
2000
1000
0
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 190 °C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
duration(s)
10^3


7Z59116
10
$Z_{th\ j-mb}$
(°C/W)
1
10^{-1}
10^{-2}
10^{-3}
transient thermal impedance from junction to mounting base versus time
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
time(s)
10^3

APPLICATION INFORMATION AND OPERATING NOTES

See general pages at the beginning of this section.

FAST RECOVERY RECTIFIER DIODES WITH CONTROLLED AVALANCHE

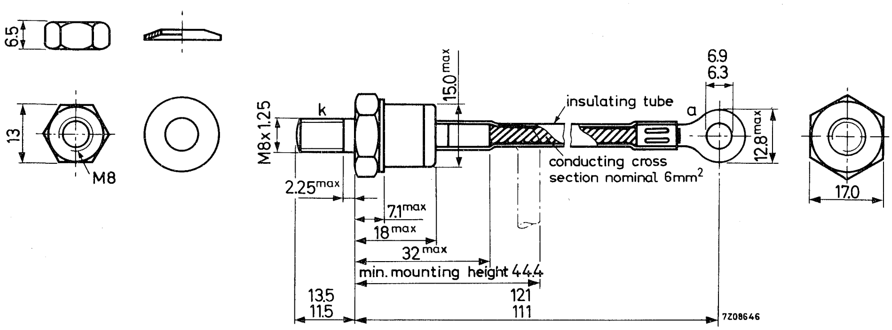
Diffused silicon diodes in a metal envelope, capable of absorbing transients. They are primarily intended for use in high frequency power supplies, inverters, choppers, sonar power supplies and ultra sonic systems.
The series consists of the normal polarity types (cathode to stud) BYX34-200 to BYX34-500.

QUICK REFERENCE DATA

			BYX34 − 200	300	400	500	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	250	375	500	625	V

Average forward current up to $T_{mb} = 105\ ^oC$	$I_{F(AV)}$	max.	70	A
at $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	40	A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 150\ ^oC$ prior to surge	I_{FSM}	max.	1200	A
Non-repetitive peak reverse power dissipation ($t = 10\ \mu s$; $T_j = 25\ ^oC$)	P_{RSM}	max.	30	kW
Junction temperature	T_j	max.	150	^oC
Reverse recovery charge when switched from $I_F = 50$ A to $V_R \geq 30$ V with $-\frac{dI}{dt} = 50\ A/\mu s$; $T_j = 25\ ^oC$	Q_s	<	7.5	μC

MECHANICAL DATA Dimensions in mm



Net weight: 42 g
Diameter of clearance hole: max. 8.5 mm

Torque on nut: min 40 kg cm (4 Newton-metres)
max. 60 kg cm (6 Newton-metres)

All information applies to frequencies up to 50 kHz.

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

Voltages [1]		BYX34 –	200	300	400	500	
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) up to T_{mb} = 105 °C	$I_{F(AV)}$	max.	70	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
Forward current (d.c.)	I_F	max.	120	A
R.M.S. forward current	$I_{F(RMS)}$	max.	120	A
Repetitive peak forward current	I_{FRM}	max.	1000	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 150 °C prior to surge	I_{FSM}	max.	1200	A
I squared t for fusing (t = 10 ms)	I^2t	max.	7200	A^2s
Rate of change of commutation current	$-\frac{dI}{dt}$	max.	100	A/µs

Reverse power dissipation

Average reverse power dissipation (averaged over any 20 ms period)	$P_{R(AV)}$	max.	30	W
Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 150 °C	P_{RRM}	max.	8	kW
Non-repetitive peak reverse power dissipation; t = 10 µs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	30	kW
T_j = 150 °C prior to surge	P_{RSM}	max.	15	kW

Temperatures

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

[1]) To ensure thermal stability $R_{th\ j-a} \leq 0.75$ °C/W (continuous reverse voltage) or ≤ 15 °C/W (a.c.)
For smaller heatsinks $T_{j\,max}$ should be derated. For a.c. see page 4.
For continuous reverse voltage: $R_{th\ j-a}$ = 1 °C/W, then $T_{j\,max}$ = 145 °C
$R_{th\ j-a}$ = 1.2 °C/W, then $T_{j\,max}$ = 140 °C

THERMAL RESISTANCE

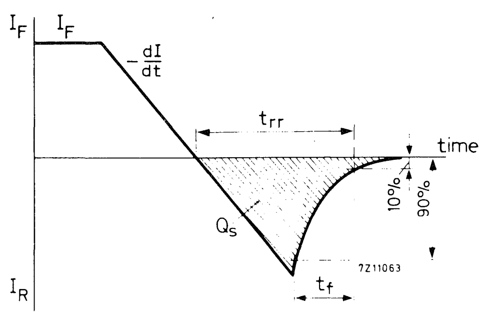
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.4	°C/W
with heatsink compound (e.g. Dow Corning 340)	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.045	°C/W

CHARACTERISTICS

			BYX34 – 200	300	400	500	
Forward voltage							
I_F = 250 A; T_j = 25 °C	V_F	<	1.8	1.8	1.8	1.8	V[1])
Reverse breakdown voltage							
I_R = 10 mA; T_j = 25 °C	$V_{(BR)R}$	>	250	375	500	625	V
		<	900	900	900	900	V
Reverse current							
$V_{RM} = V_{RWM\,max}$; T_j = 125 °C	I_{RM}	<	25	25	18	15	mA

Reverse recovery when switched
from I_F = 50 A to $V_R \geq$ 30 V
with – dI/dt = 50 A/µs; T_j = 25 °C

reverse recovery charge	Q_s	<	7.5	µC
reverse recovery time	t_{rr}	<	0.7	µs
fall time	t_f	<	0.3	µs



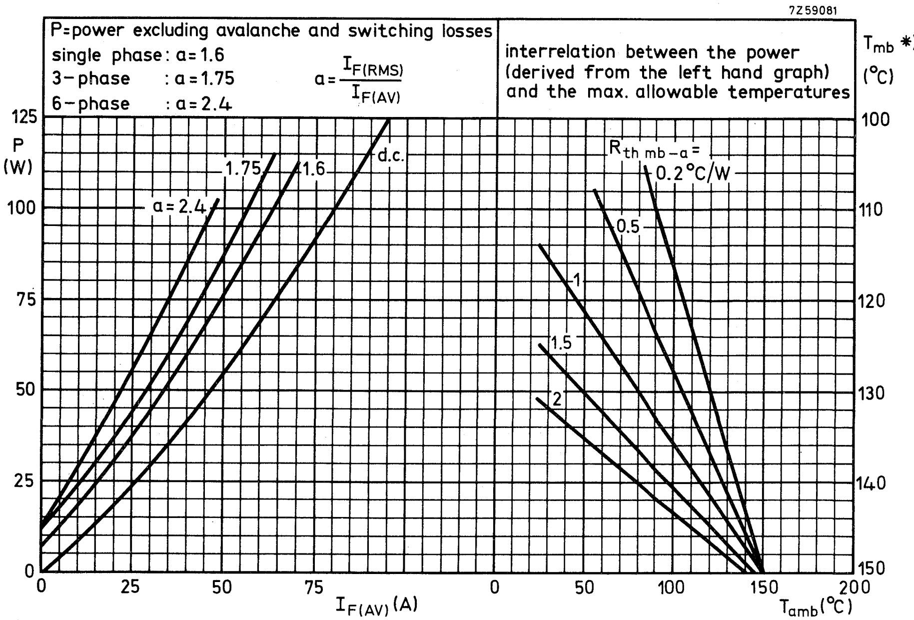
1) Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (See also general pages at the beginning of this section)

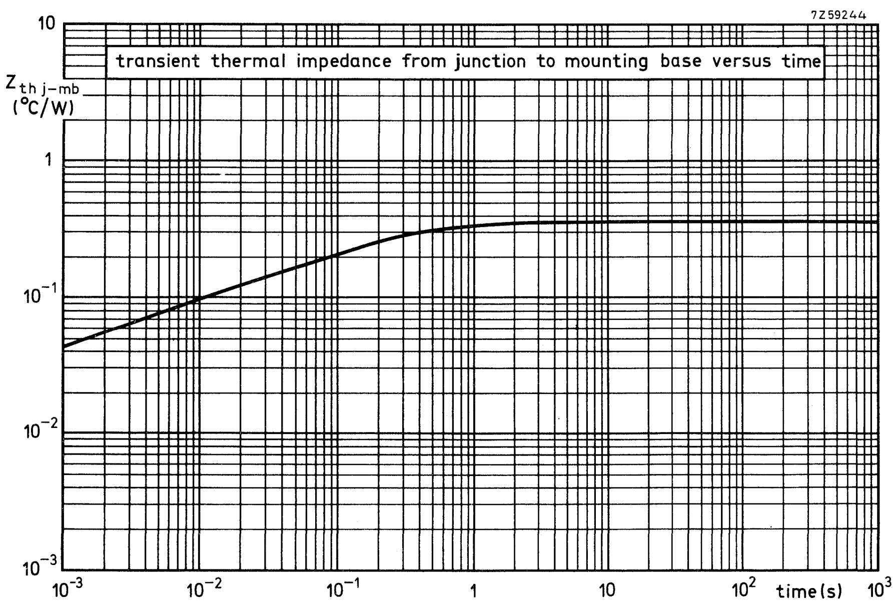
1. Square wave operation
   When I_F has been flowing sufficiently long for steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure on page 3). The majority of the power dissipation due to the reverse transient occurs during t_f as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the upper graph on page 5.
2. Sine wave operation
   Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of -dI/dt), so that power loss due to reverse recovery may be safely ignored for frequencies up to 20 kHz.

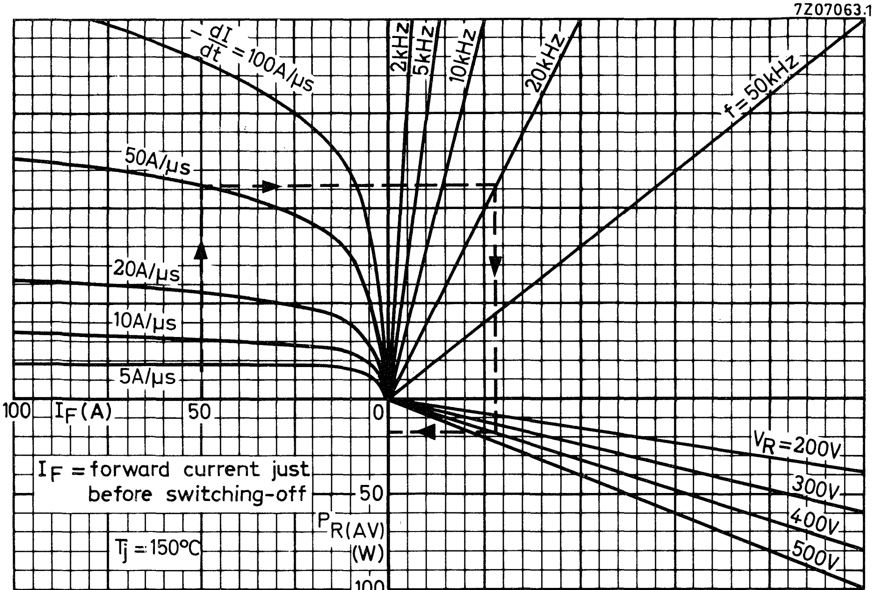
APPLICATION INFORMATION

See general pages of the beginning of this section.

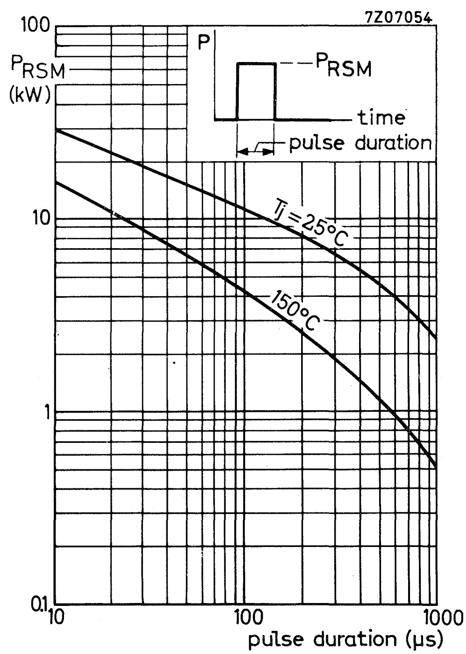


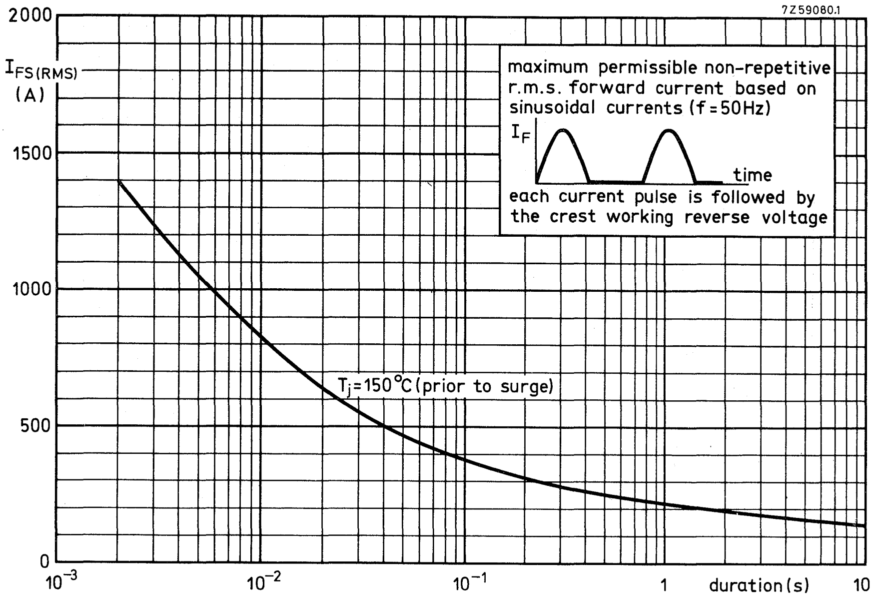
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.1\ ^\circ C/W$

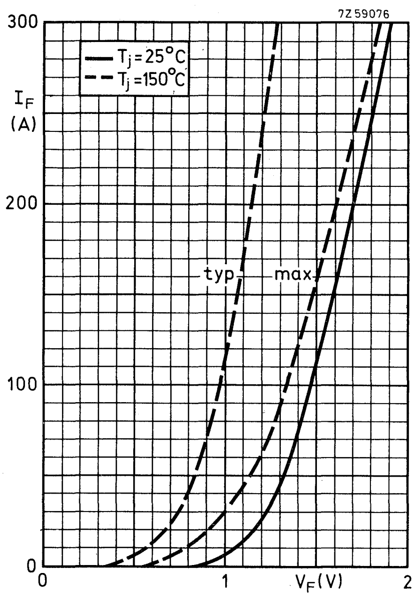


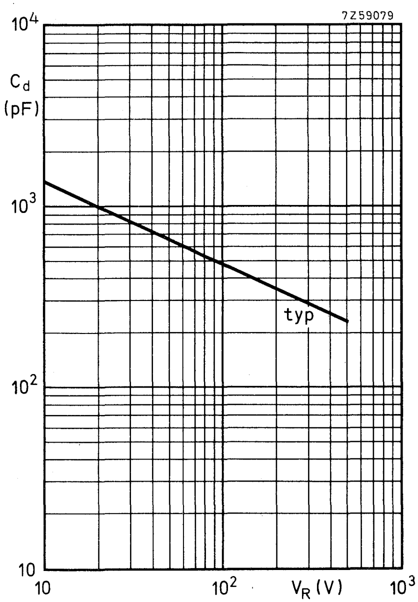


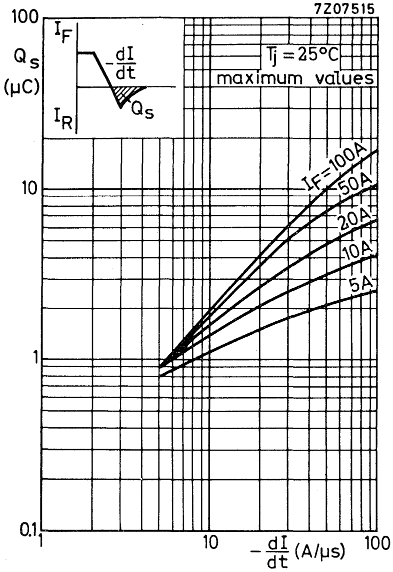
Nomogram: Power loss $P_{R(AV)}$ due to switching only (square wave operation)

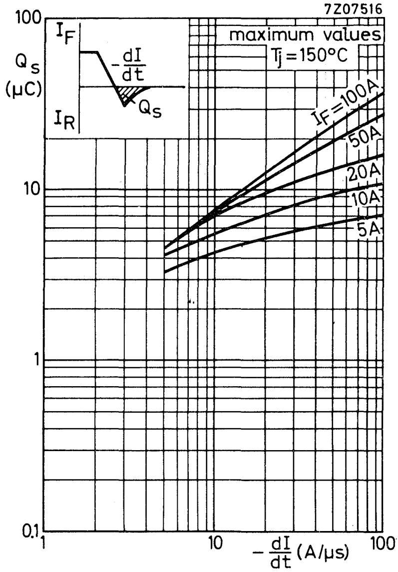


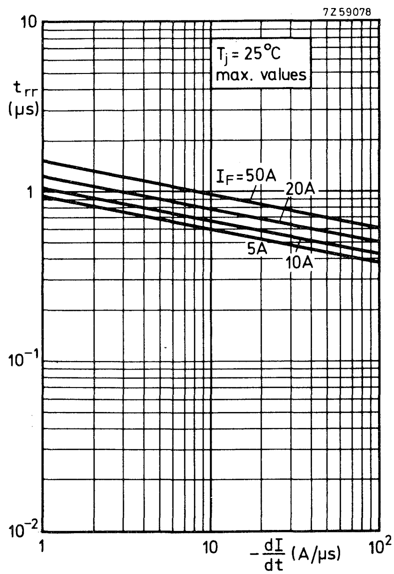

7Z59080.1
2000
$I_{FS(RMS)}$
(A)
1500
1000
500
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 150 °C (prior to surge)

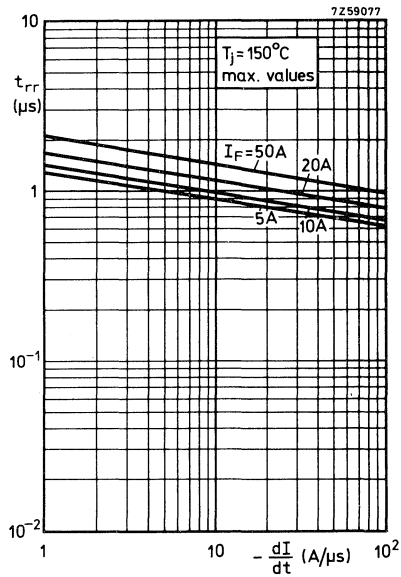

7Z59076
300
I_F
(A)
200
100
0
0
1
V_F (V)
2
T_j = 25 °C
T_j = 150 °C
typ
max


7Z59079
10^4
C_d
(pF)
10^3
10^2
10
10
10^2
V_R (V)
10^3
typ


7Z07515
100
Q_s
(μC)
I_F
$-\frac{dI}{dt}$
Q_s
I_R
$T_j = 25°C$
maximum values
I_F=100A
50A
20A
10A
5A
10
1
0.1
1
10
$-\frac{dI}{dt}$ (A/μs)
100


7Z07516
100
Q_s
(μC)
I_F
$-\frac{dI}{dt}$
Q_s
I_R
maximum values
$T_j = 150°C$
I_F=100A
50A
20A
10A
5A
10
1
0.1
1
10
$-\frac{dI}{dt}$ (A/μs)
100


7Z59078
10
t_{rr}
(μs)
$T_j = 25°C$
max. values
I_F=50A
20A
5A
10A
1
10^{-1}
10^{-2}
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2


7Z59077
10
t_{rr}
(μs)
$T_j = 150°C$
max. values
I_F=50A
20A
5A
10A
1
10^{-1}
10^{-2}
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2

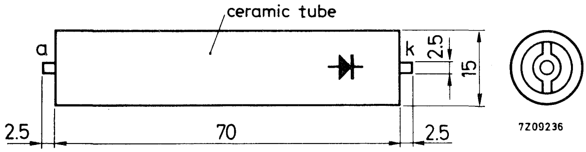
SILICON HIGH VOLTAGE DIODE

The BYX35 is primarily intended for the high voltage power supply of X-ray, electron microscope and LASER equipment.
The device is in a ceramic tube and must be immersed in oil for cooling and insulating.
The diodes can be connected in series, without voltage equalizing elements, for higher voltage applications.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	25	kV
Repetitive peak reverse voltage	V_{RRM}	max.	37.5	kV
Average forward current	I_{FAV}	max.	0.05	A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.	15	A

MECHANICAL DATA

Dimensions in mm



Net weight : 42 g
With accessories: 44 g

For mounting instructions see page 3.

All information applies to frequencies from 40 up to 400 Hz.

RATINGS (Limiting values) [1])

Voltages

Crest working reverse voltage	V_{RWM}	max.	25	kV
Repetitive peak reverse voltage	V_{RRM}	max.	37.5	kV
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	40	kV

Currents

Continuous operation				
Average forward current (averaged over any 20 ms period) $T_{oil} \leq 50\,^{o}C$	I_{FAV}	max.	0.05	A
Repetitive peak forward current	I_{FRM}	max.	0.16	A
Non repetitive peak forward current ($t = 10$ ms)	I_{FSM}	max.	15	A
Intermittent operation				
Average forward current (averaged over any 20 ms period) $T_{oil} \leq 50\,^{o}C$ ($t \leq 0.5$ s once every 18 s)	I_{FAV}	max.	0.5	A
Repetitive peak forward current ($t \leq 0.5$ s once every 18 s)	I_{FRM}	max.	1.6	A

Temperatures

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

THERMAL RESISTANCE

From junction to cooling oil	$R_{th\ j\text{-}o}$	=	8	$^{o}C/W$

CHARACTERISTICS

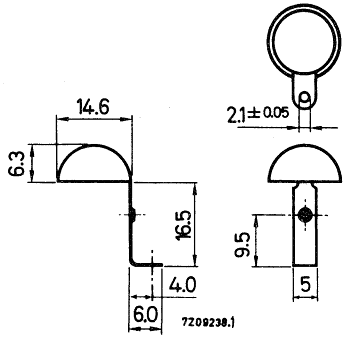
Forward voltage at $I_F = 10$ mA; $T_j = 25\,^{o}C$	V_F	typ.	25	V
Diode capacitance at $T_j = 25\,^{o}C$	C_d	typ.	45	pF

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

MOUNTING INSTRUCTIONS

Dimensions in mm

Each diode is supplied with 2 anti-corona caps.



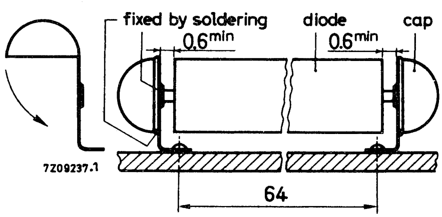
1. Mount clip on board.
2. Solder diode into fixing hole. Solder temperature: max. 300 °C; duration: max. 5 s.
3. Bend anti-corona cap down in direction of arrow and solder into position.

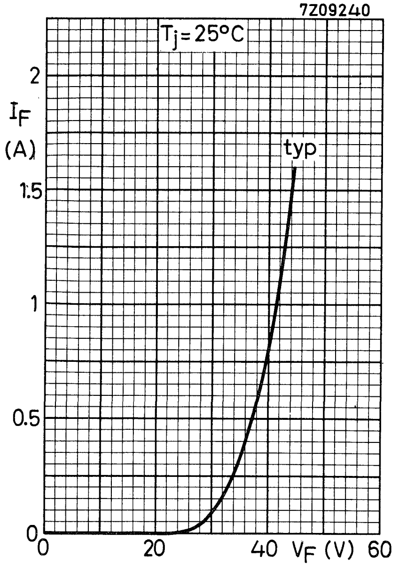
Notes:

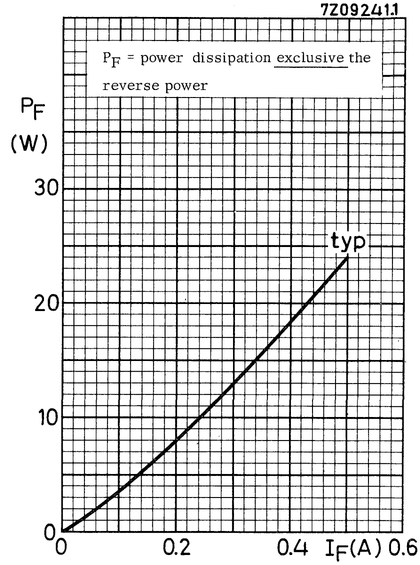
a. For good heat transfer and insulation, the devices must be immersed in oil.

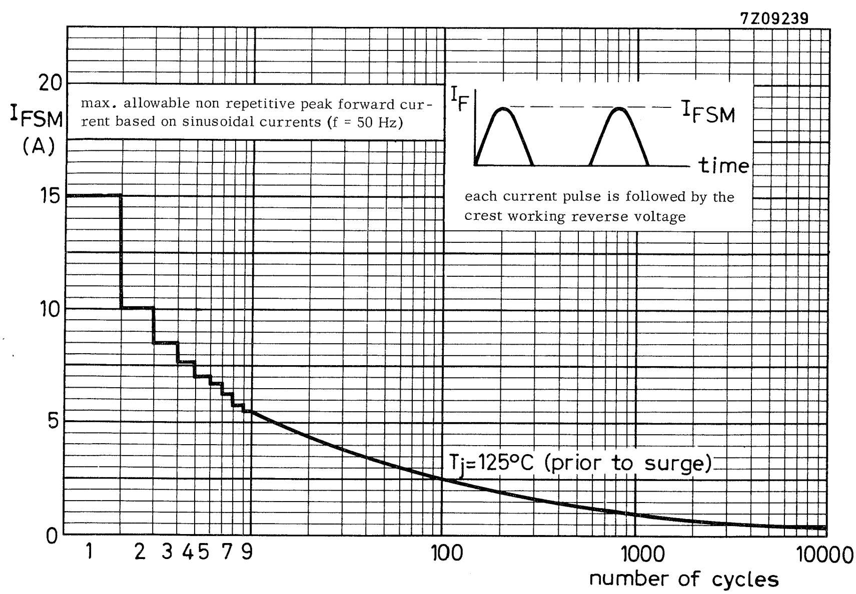
b. Any mounting position can be used.

c. Use acid free soldering flux.




7Z09240
$T_j = 25°C$
I_F (A)
typ
0
0.5
1
1.5
2
0
20
40
V_F (V)
60


7Z09241.1
P_F = power dissipation exclusive the reverse power
P_F (W)
typ
0
10
20
30
0
0.2
0.4
I_F(A)
0.6


7Z09239
I_{FSM} (A)
max. allowable non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
T_j=125°C (prior to surge)
0
5
10
15
20
1
2
3
4
5
7
9
100
1000
10000
number of cycles

SILICON RECTIFIER DIODES

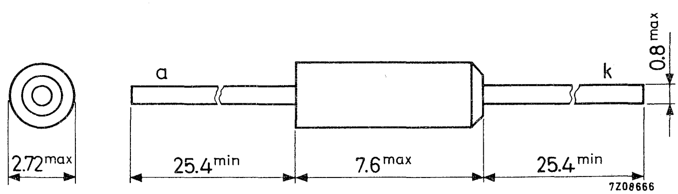
Diffused silicon rectifier diodes in a DO-15 plastic envelope for general purposes. The series consists of the following types: BYX36-150, BYX36-300, BYX36-600.

QUICK REFERENCE DATA

			BYX36- 150	300	600	
Crest working reverse voltage	V_{RWM}	max.	100	200	400	V
Repetitive peak reverse voltage	V_{RRM}	max.	150	300	600	V
Average forward current with R-load up to T_{amb} = 40 °C	I_{FAV}	max.		0.8		A
Junction temperature	T_j	max.		125		°C

MECHANICAL DATA Dimensions in mm

DO-15



The coned end indicates the cathode

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

Voltages			BYX36-150	300	600	
Continuous reverse voltage	V_R	max.	100	200	400	V
Crest working reverse voltage	V_{RWM}	max.	100	200	400	V
Repetitive peak reverse voltage	V_{RRM}	max.	150	300	600	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	150	300	600	V

Currents				
Average forward current (averaged over any 20 ms period) for R-load up to T_{amb} = 40 °C	I_{FAV}	max.	0.8	A
Forward current (d.c.) up to T_{amb} = 40 °C	I_F	max.	0.9	A
Repetitive peak forward current	I_{FRM}	max.	5	A
Non repetitive peak forward current t = 10 ms; half sine wave	I_{FSM}	max.	30	A

Temperatures				
Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

CHARACTERISTICS T_j = 25 °C unless otherwise specified

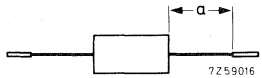
Forward voltage at I_F = 1 A [1]	V_F	typ.	0.9	V
		<	1.2	V
I_F = 5 A [1]	V_F	typ.	1.1	V
Reverse current				
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	120	μA

[1]) Measured under pulsed conditions to avoid excessive dissipation

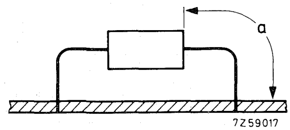
MOUNTING METHODS

The upper graph on page 4 applies when no other leads run to the tie–points. If leads of other dissipating components share the same tie–points, refer to the lower graph.

1. Mounted to solder tags at a lead-length a = 10 mm.
2. Mounted to solder tags at a = maximum lead-length.

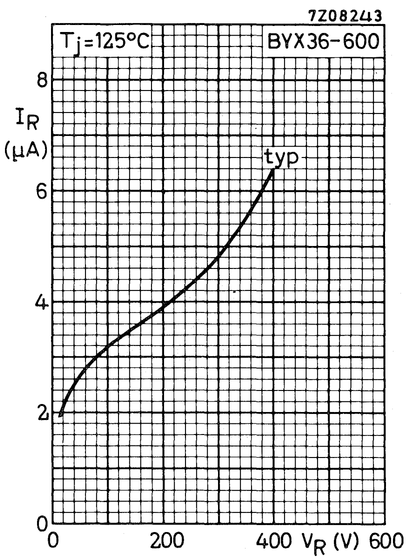


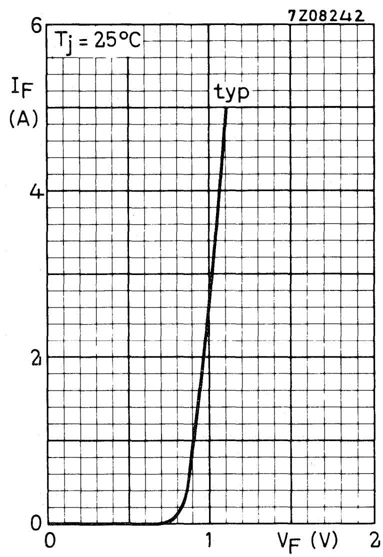
3. Mounted on printed-wiring board at a = maximum lead-length.
4. Mounted on printed-wiring board at a lead-length a = 10 mm.

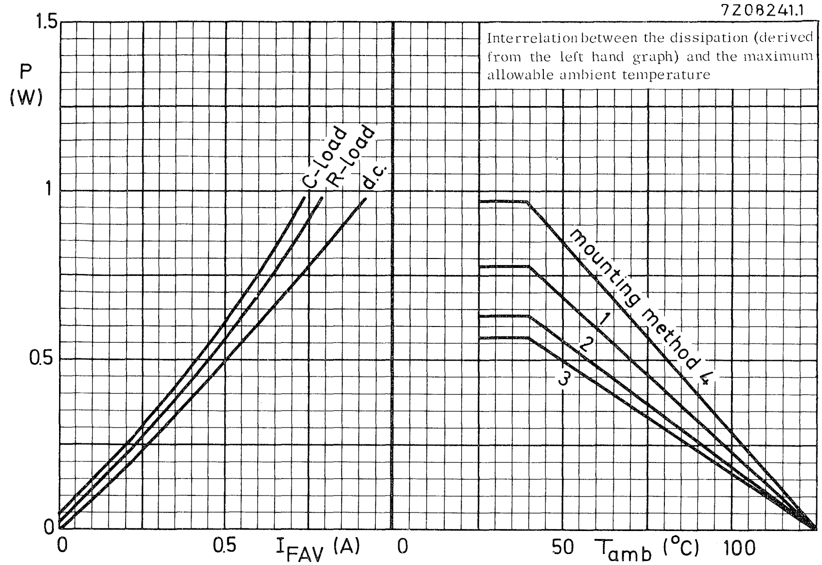


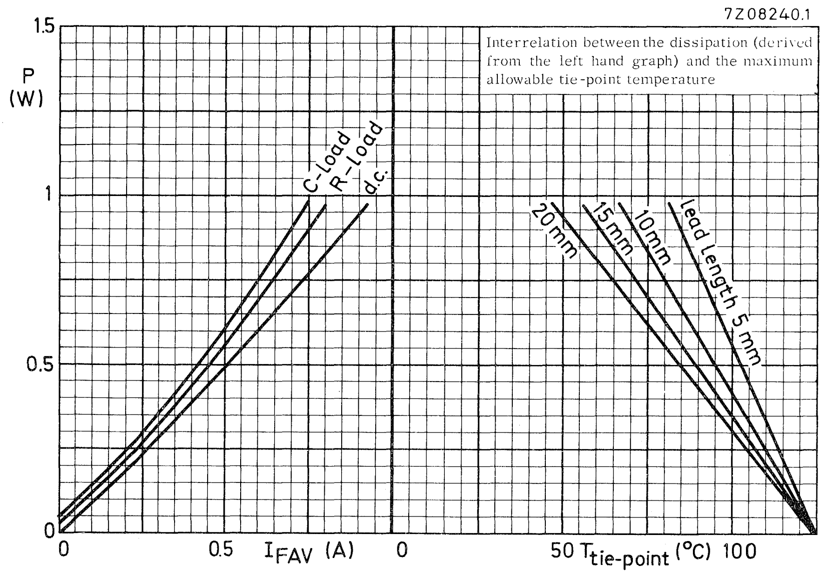
SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.






7Z08241.1
Interrelation between the dissipation (derived from the left hand graph) and the maximum allowable ambient temperature
P
(W)
1.5
1
0.5
0
C-Load
R-Load
d.c.
mounting method 4
1
2
3
0
0.5
IFAV (A)
0
50
Tamb (°C)
100


7Z08240.1
Interrelation between the dissipation (derived from the left hand graph) and the maximum allowable tie-point temperature
P
(W)
1.5
1
0.5
0
C-Load
R-Load
d.c.
20 mm
15 mm
10 mm
lead length 5 mm
0
0.5
IFAV (A)
0
50
Ttie-point (°C)
100

SILICON RECTIFIER DIODES

Diffused silicon rectifier diodes in a DO-4 metal envelope intended for power rectifier applications. The series consists of the following types.
Normal polarity (stud cathode): BYX38-300; BYX38-600; BYX38-900; BYX38-1200.
Reverse polarity (stud anode): BYX38-300R; BYX38-600R; BYX38-900R; BYX38-1200R

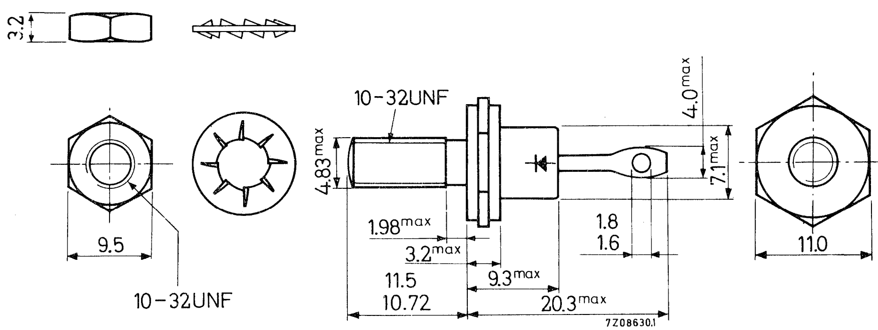
QUICK REFERENCE DATA

			BYX38-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V

Average forward current up to T_{mb} = 75 ^{o}C	I_{FAV}	max.	6	A
Junction temperature	T_j	max.	150	^{o}C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	^{o}C/W

MECHANICAL DATA Dimensions in mm

DO-4



Net weight : 4.3 g
With accessories: 6.5 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295 (56262A)

Torque on nut: min. 8 cmkg
max. 17 cmkg
The mark shown applies to normal polarity types

All information applies to the frequency range 50 to 400 Hz

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

Voltages

			BYX38-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	900	1200	V

Currents

Average forward current (averaged over any 20 ms period) $T_{mb} = 75\ ^oC$	I_{FAV}	max.	6.0	A
$T_{mb} = 125\ ^oC$	I_{FAV}	max.	2.5	A
Forward current (d.c.) $T_{mb} = 90\ ^oC$	I_F	max.	6.0	A
$T_{mb} = 125\ ^oC$	I_F	max.	3.0	A
Repetitive peak forward current	I_{FRM}	max.	20	A
Non repetitive peak forward current $t = 10$ ms (see also page A) $T_j = 125\ ^oC$	I_{FSM}	max.	38	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	7.3	A^2s

Temperatures

Storage temperature	T_{stg}		-55 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	$^oC/W$

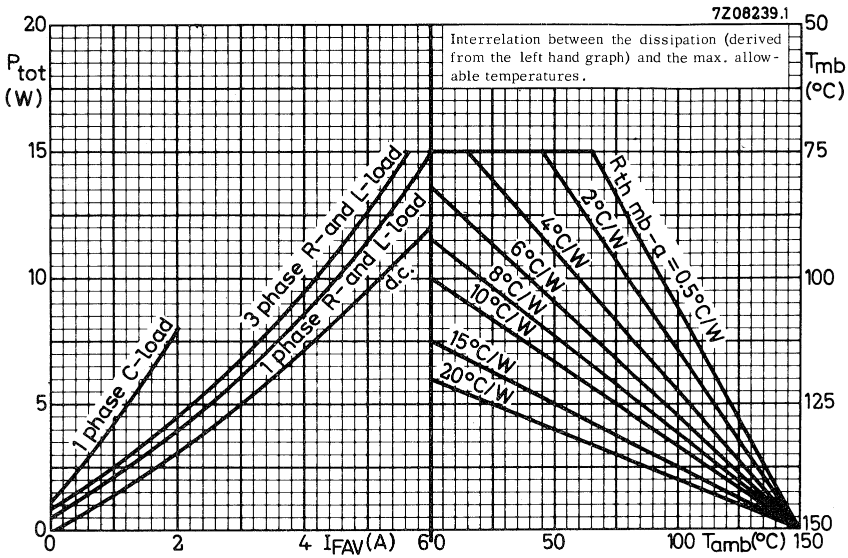
CHARACTERISTICS $T_j = 25\ ^oC$ unless otherwise specified

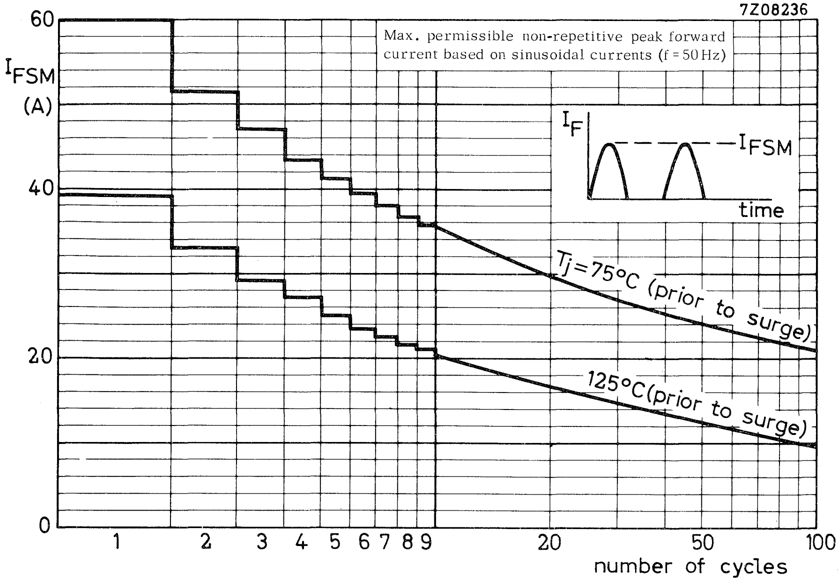
Forward voltage at	$I_F = 5$ A [1]	V_F	<	1.7	V
	$I_F = 15$ A [1]	V_F	<	2.1	V
Reverse current	$V_R = V_{RWMmax}$	I_R	<	10	μA
	$V_R = V_{RWMmax}$; $T_j = 125\ ^oC$	I_R	<	200	μA

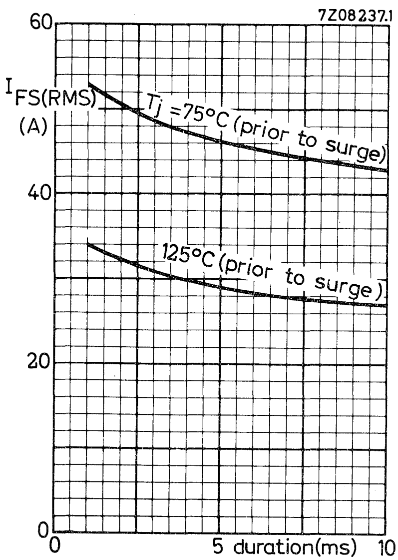
[1]) Measured under pulsed conditions to avoid excessive dissipation.

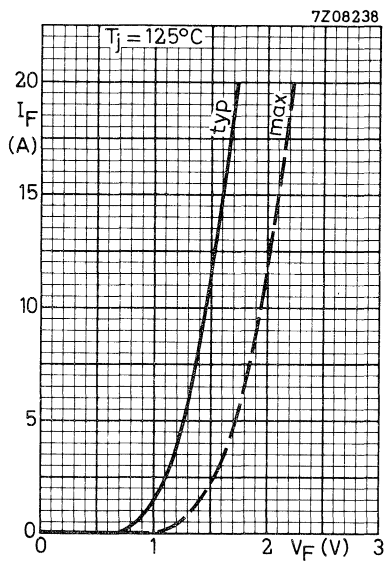
OPERATING NOTE (See also general pages at the beginning of this section)

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that 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.



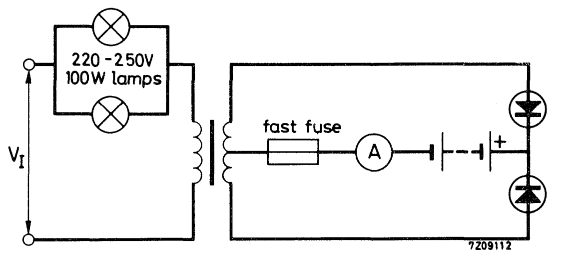

7Z08236
Max. permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_{FSM} (A)
60
40
20
0
I_F
I_{FSM}
time
T_j = 75°C (prior to surge)
125°C (prior to surge)
1
2
3
4
5
6
7
8
9
20
50
100
number of cycles


7Z08237.1
$I_{FS(RMS)}$ (A)
60
40
20
0
T_j = 75°C (prior to surge)
125°C (prior to surge)
0
5
duration (ms)
10


7Z08238
T_j = 125°C
I_F (A)
20
15
10
5
0
typ
max
0
1
2
V_F (V)
3

APPLICATION INFORMATION

Protected battery charger with BYX38-300



Both rectifier diodes are mounted on a 15 cm x 15 cm vertically mounted 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:

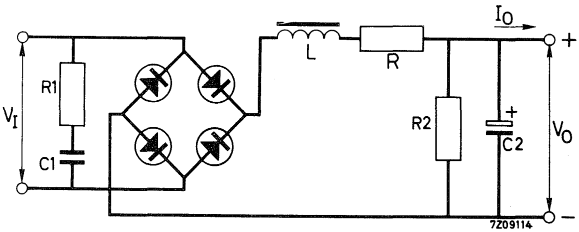
n (primary to half secondary)	0.094	
$V_{T(RMS)}$	150	V
$I_{primary\,(rms)}$	0.75	A
$I_{secondary\,(rms)}$	4.5	A
$I_{primary}$ (off-load saturation current with two 100 W lamps in parallel, connected in series with primary)	0.6	A

APPLICATION INFORMATION (continued)

Full wave rectifier circuit with choke input filter

Operating ambient temperature T_{amb} up to 50 °C

		BYX38-600(R)	900(R)	1200(R)	
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

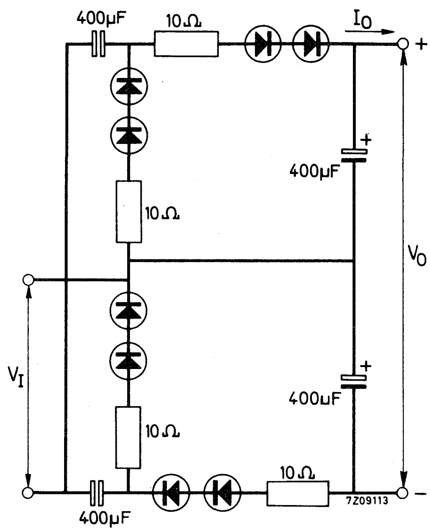
	BYX38-600(R)	900(R)	1200(R)	
R1	220	220	390	Ω [1]
C1	1.0	1.0	0.5	μF [1]
L	0.5	1.0	1.0	H
	(R = 3)	(R = 5)	(R = 5)	Ω
R2	200	300	400	Ω
	(50)	(75)	(100)	W
C2	500	250	250	μF

[1]) RC damping circuit; see operating notes on page 3.

APPLICATION INFORMATION (continued)

Voltage quadrupler circuit with BYX38-1200(R)

Operating ambient temperature	T_{amb}	up to	50	°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.

CONTROLLED AVALANCHE RECTIFIER DIODES

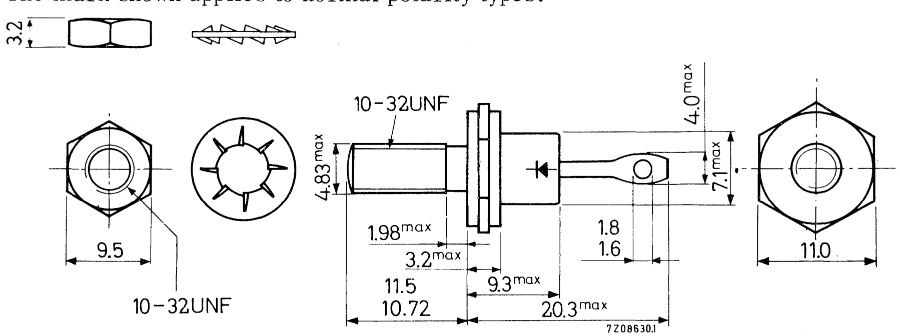
Silicon diodes in a DO-4 metal envelope, capable of absorbing transients and intended for power rectifier application.
The series consists of the following types:
Normal polarity (stud cathode): BYX39-600; BYX39-800; BYX39-1000
Reverse polarity (stud anode): BYX39-600R; BYX39-800R; BYX39-1000R

QUICK REFERENCE DATA

			BYX39-600(R)	800(R)	1000(R)
Crest working reverse voltage	V_{RWM}	max.	600	800	1000 V
Average forward current	I_{FAV}	max.		6 A	
Non repetitive peak forward current; t = 10 ms; T_j = 125 °C	I_{FSM}	max.		100 A	
Repetitive peak reverse power t = 10 µs; T_j = 125 °C	P_{RRM}	max.		2 kW	
Non repetitive peak reverse power t = 10 µs; T_j = 25 °C	P_{RSM}	max.		4 kW	
Junction temperature	T_j	max.		175 °C	

MECHANICAL DATA

DO-4
The mark shown applies to normal polarity types.



Net weight : 4.3 g
With accessories: 6.5 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295 (56262A)

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

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages [2]			BYX39-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	6.0	A
Forward current (d.c.)	I_F	max.	6.8	A
R.M.S. forward current	$I_{F(RMS)}$	max.	9.5	A
Repetitive peak forward current	I_{FRM}	max.	120	A
Non repetitive peak forward current $t = 10$ ms; $T_j = 125$ °C; see also page 7	I_{FSM}	max.	100	A
I squared t for fusing	See curves at page 7			

Reverse power dissipation

Reverse power (averaged over any 20 ms period)	P_{RAV}	max.	10	W
Repetitive peak reverse power at f = 50 Hz square wave; t = 10 μs; $T_j = 125$ °C (see also pages 5 and 6)	P_{RRM}	max.	2	kW
Non repetitive peak reverse power square wave; see also page 6 t = 10 μs; $T_j = 25$ °C	P_{RSM}	max.	4	kW
$T_j = 175$ °C	P_{RSM}	max.	0.8	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) To ensure thermal stability: $R_{th\ j-a} < 20$ °C/W (a.c.)
For smaller heatsinks T_j max. should be derated.
(see also page 5)

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50 °C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4.5 °C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5 °C/W

CHARACTERISTICS

Voltages			BYX39-600(R)	800(R)	1000(R)	
Forward voltage at						
I_F = 20 A; T_j = 25 °C	V_F	<	2.0	2.0	2.0	V [1]
Reverse breakdown voltage (see also page 8)						
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V
		<	1600	1600	1600	V
Currents						
Reverse current at T_j = 125 °C						
V_R = 600 V	I_R	<	150			μA
V_R = 800 V	I_R	<		150		μA
V_R = 1000 V	I_R	<			150	μA

OPERATING NOTES (See also general pages at the beginning of this section.)

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. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves at page 7 a fast fuse is recommended.

3. The top connector should neither be bent nor twisted; 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.

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

Determination of the heatsink thermal resistance.

Example:

Assume a diode, used in a single phase rectifier circuit.

frequency	f	=	50	Hz
average forward current	I_{FAV}	=	3	A (per diode)
ambient temperature	T_{amb}	=	70	^oC
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	=	0.5	kW (per diode)
duration of P_{RRM}	t	=	70	μs

From the left hand part of the upper graph on page 5 it follows that at I_{FAV} = 3 A in a single phase rectifier circuit the average forward power + average leakage power = 4.9 W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{70\ \mu s}{20\ ms} = 0.0035$$

Thus: $P_{RAV} = 0.0035 \times 0.5\ kW = 1.75\ W$.

Therefore the total device power dissipation $P_{tot} = (4.9 + 1.75)\ W = 6.65\ W$ (point B).

In order to avoid excessive peak junction temperatures resulting from the pulse character to the repetitive peak reverse power in the avalanche region, the value of the maximum junction temperature should be reduced. If the repetitive peak reverse power in the avalanche region is 0.5 kW; t = 70 μs; f = 50 Hz, the maximum allowable junction temperature should be 167 ^oC instead of 175 ^oC, thus 8 ^oC lower (see the lower graph on page 5).

Allowance can be made for this by assuming an ambient temperature 8 ^oC higher than before, in this case 78 ^oC instead of 70 ^oC.

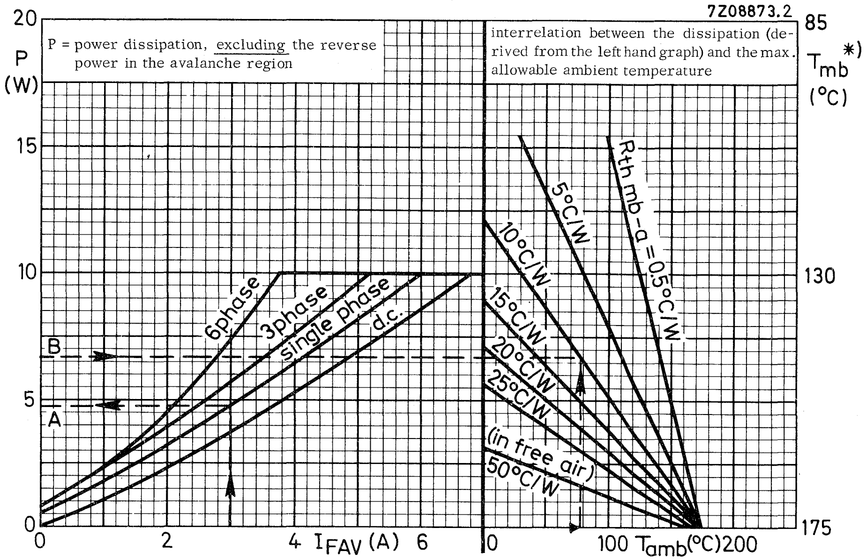
Using this in the curve leads to a thermal resistance

$$R_{th\ mb-a} \approx 10\ ^oC/W$$

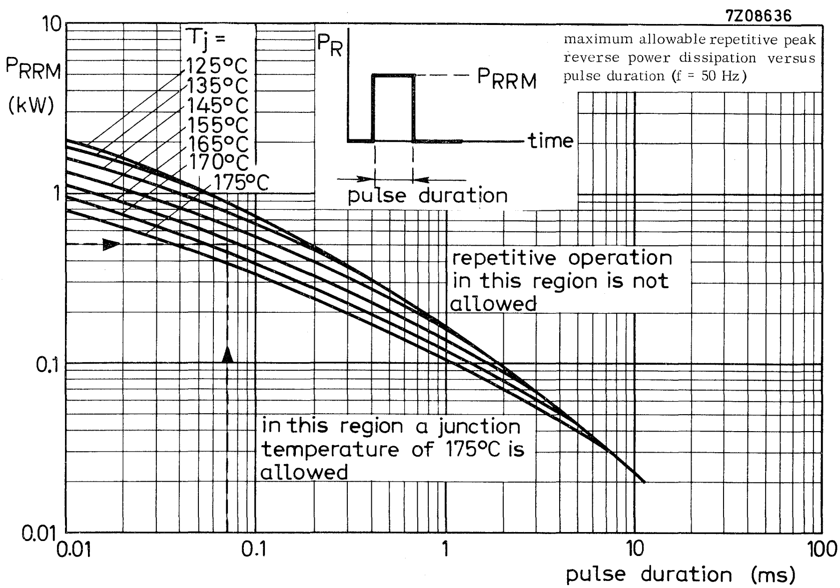
The contact thermal resistance $R_{th\ mb-h} = 0.5\ ^oC/W$.
Hence the heatsink thermal resistance should be:

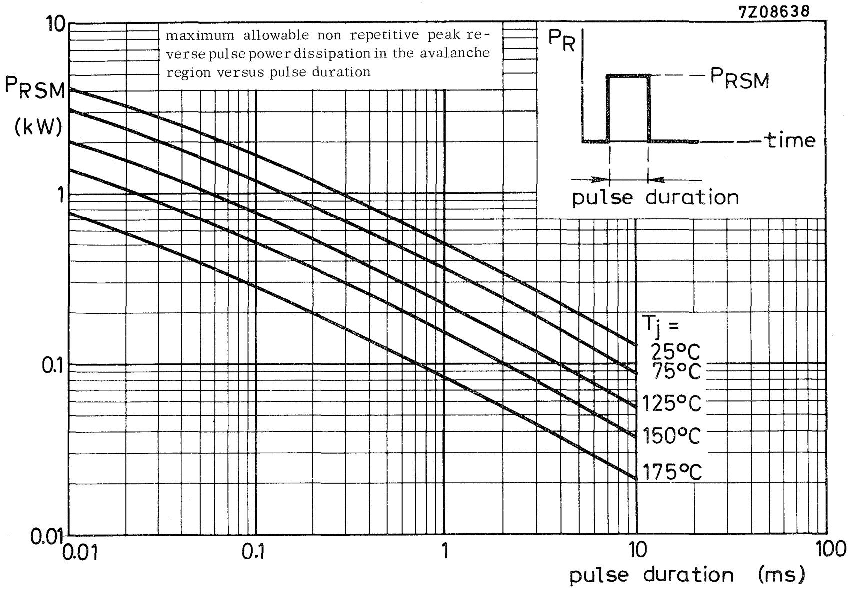
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (10 - 0.5)\ ^oC/W = 9.5\ ^oC/W$$

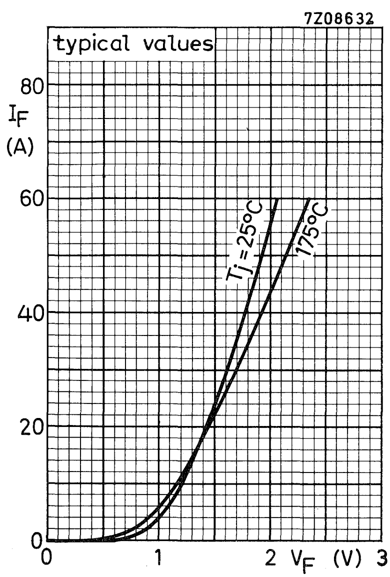
The applicable heatsink(s) may then be found in the Section HEATSINKS.

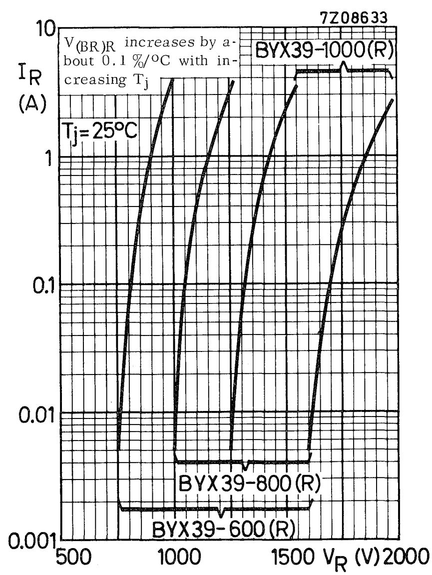


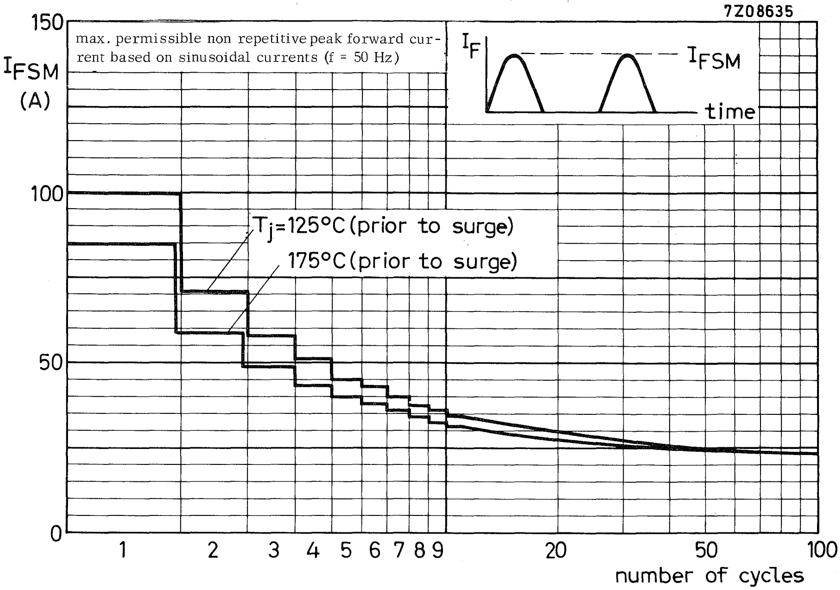
* T_{mb}-scale is for comparison purposes only and is correct only for R_{th} mb-a < 15.5 °C/W

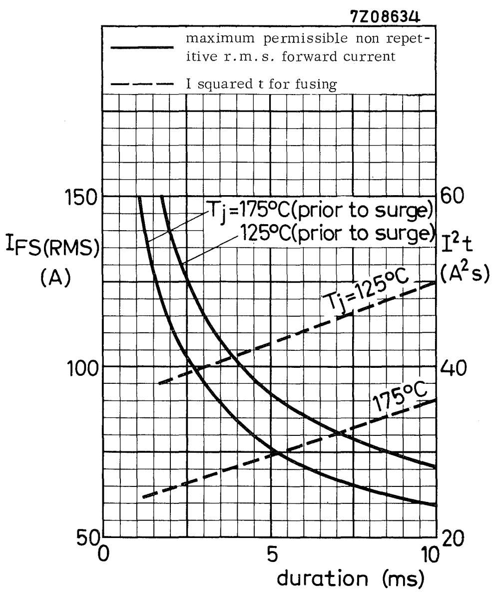



7Z08638
maximum allowable non repetitive peak reverse pulse power dissipation in the avalanche region versus pulse duration
P_{RSM} (kW)
10
1
0.1
0.01
0.01
0.1
1
10
100
pulse duration (ms)
P_R
P_{RSM}
time
pulse duration
T_j =
25°C
75°C
125°C
150°C
175°C


7Z08632
typical values
I_F (A)
80
60
40
20
0
0
1
2
V_F (V)
3
T_j=25°C
175°C


7Z08633
$V_{(BR)R}$ increases by about 0.1 %/°C with increasing T_j
BYX39-1000(R)
I_R (A)
10
1
0.1
0.01
0.001
T_j=25°C
BYX39-800(R)
BYX39-600(R)
500
1000
1500
V_R (V)
2000


7Z08635
max. permissible non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_FSM
time
150
I_FSM
(A)
100
50
0
T_j=125°C (prior to surge)
175°C (prior to surge)
1
2
3
4
5
6
7
8
9
20
50
100
number of cycles


7Z08634
maximum permissible non repetitive r.m.s. forward current
I squared t for fusing
150
I_FS(RMS)
(A)
100
50
T_j=175°C(prior to surge)
125°C(prior to surge)
60
I²t
(A²s)
40
20
T_j=125°C
175°C
0
5
10
duration (ms)

CONTROLLED AVALANCHE RECTIFIER DIODES

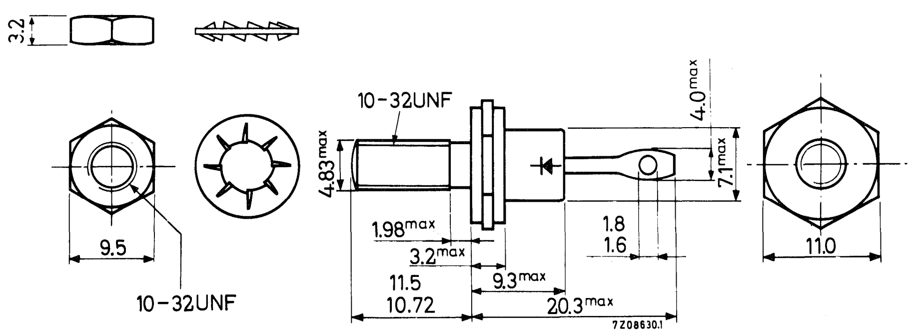
Diffused silicon diodes in a DO-4 metal envelope, capable of absorbing transients and intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX40-600, BYX40-800, BYX40-1000.
Reverse polarity (anode to stud): BYX40-600(R), BYX40-800(R), BYX40-1000(R).

QUICK REFERENCE DATA

			BYX40-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	V
Average forward current up to T_{mb} = 125 °C	$I_{F(AV)}$	max.		12		A
Non-repetitive peak forward current; t = 10 ms; T_j = 175 °C prior to surge	I_{FSM}	max.		180		A
Non-repetitive peak reverse power t = 10 µs; T_j = 25 °C	P_{RSM}	max.		8		kW
Junction temperature	T_j	max.		175		°C

MECHANICAL DATA Dimensions in mm

DO-4
The mark shown applies to normal polarity types.



Net weight : 6.5 g

Torque on nut: min. 8 kg cm (0.8 Newton-metres)
max. 17 kg cm (1.7 Newton-metres)

Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request: 56295 (56262A)

All information applies to frequencies **up to 400 Hz**

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

Voltages [1]			BYX40-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current up to T_{mb} = 125 °C (averaged over any 20 ms period)	$I_{F(AV)}$	max.	12	A
Forward current (d.c.) at T_{mb} = 125 °C	I_F	max.	19	A
R.M.S. forward current	$I_{F(RMS)}$	max.	19	A
Repetitive peak forward current	I_{FRM}	max.	250	A
Non-repetitive peak forward current t = 10 ms; **half sine wave** T_j = 175 °C prior to surge	I_{FSM}	max.	180	A
I squared t for fusing (t = 10 ms)	I^2t	max.	162	A^2s

RATINGS (continued)

Reverse power dissipation

Repetitive peak reverse power dissipation $t = 10\ \mu s$ (square wave: $f = 50$ Hz) $T_j = 175\ ^oC$	P_{RRM}	max.	**1.2**	kW
Non-repetitive peak reverse power dissipation; $t = 10\ \mu s$ $T_j = 25\ ^oC$ prior to surge	P_{RSM}	max.	8	kW
$T_j = 175\ ^oC$ prior to surge	P_{RSM}	max.	1.2	kW

Temperatures

Storage temperature	T_{stg}	−55 to +175		^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	$^oC/W$
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.2	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	$^oC/W$

CHARACTERISTICS

Voltages

			BYX40-600(R)	800(R)	1000(R)	
Forward voltage at $I_F = 50$ A; $T_j = 25\ ^oC$	V_F	<	2.5	2.5	2.5	V [1]
Reverse avalanche breakdown voltage $I_R = 5$ mA; $T_j = 25\ ^oC$	$V_{(BR)R}$	>	750	1000	1250	V [2]
		<	2000	2000	2000	V

Current

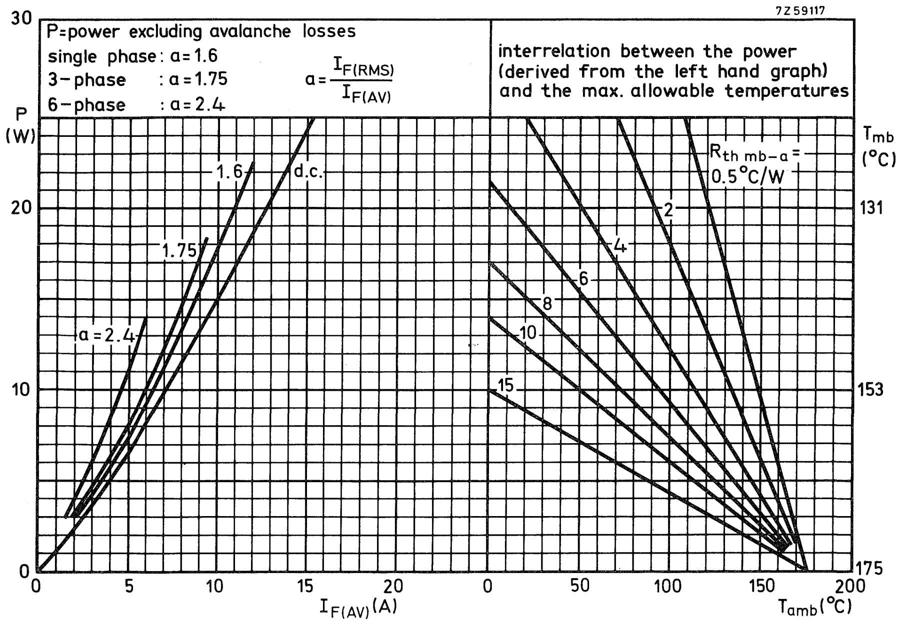
Peak reverse current at $T_j = 125\ ^oC$ $V_{RM} = V_{RWMmax}$	I_{RM}	<	300	μA

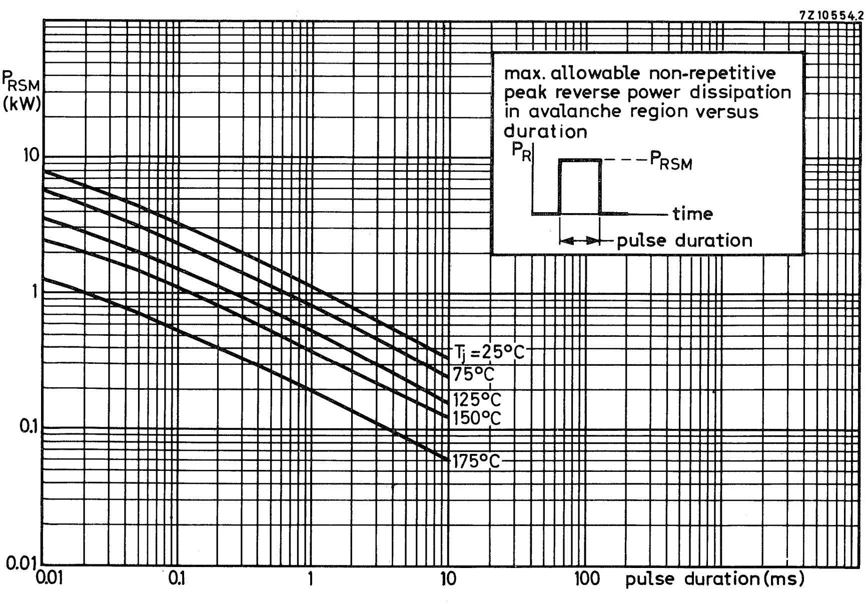
OPERATING NOTES (See also general pages at the beginning of this section)

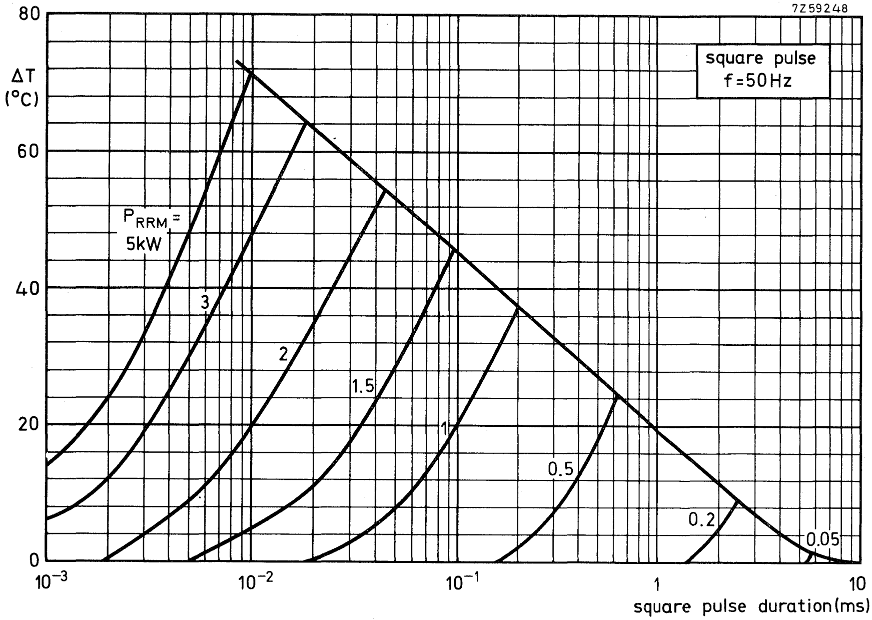
1. Voltage sharing of series connected controlled avalanche diodes.
   If diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.
2. The top connector should neither be bent not twisted; it should be soldered into the circuit so that 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.

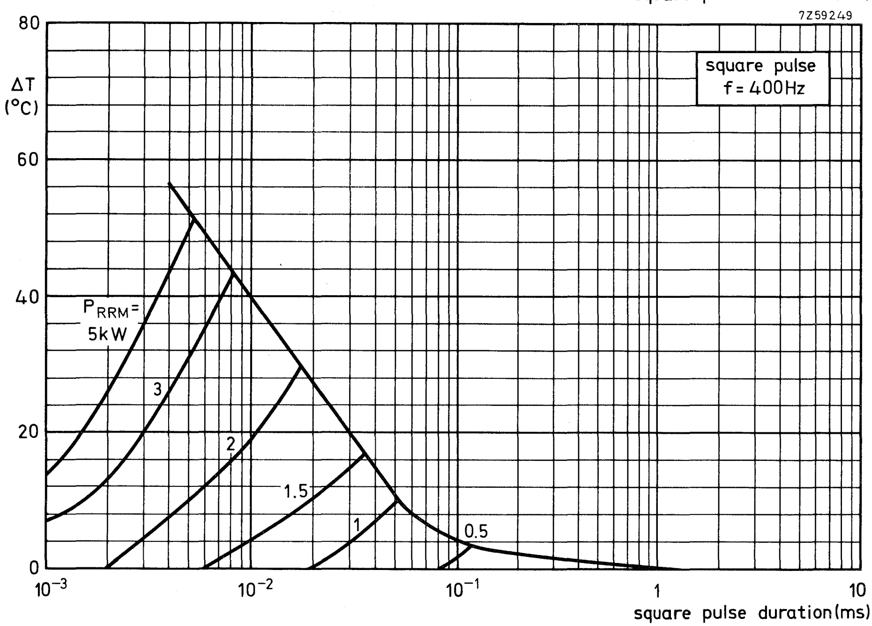
APPLICATION INFORMATION See general pages at the beginning of this section.

[1]) Measured under pulsed conditions to avoid excessive dissipation.
[2]) The avalanche breakdown voltage increases by about 0.1%/^oC with increasing junction temperature.

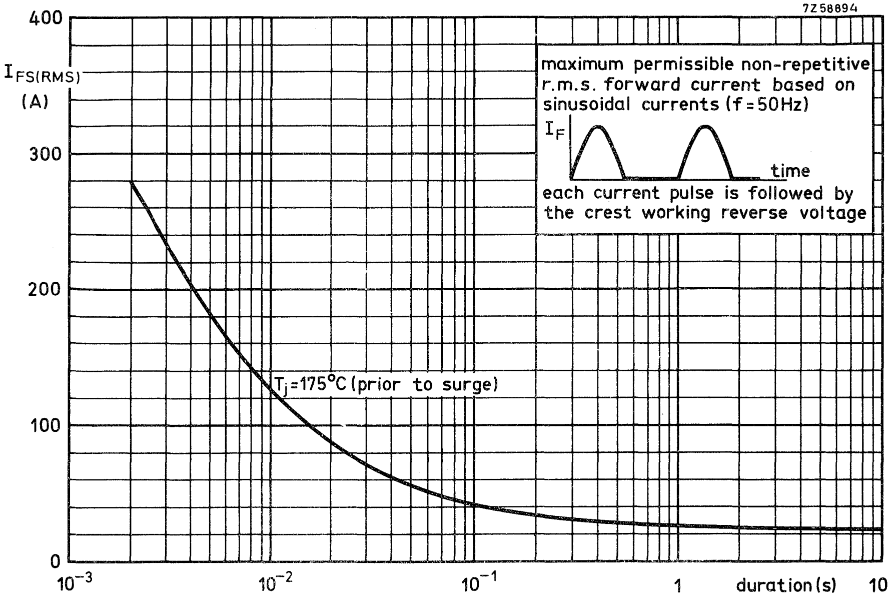

7Z59117
P=power excluding avalanche losses
single phase: a = 1.6
3−phase : a = 1.75
6−phase : a = 2.4
$a = \frac{I_{F(RMS)}}{I_{F(AV)}}$
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
$R_{th\ mb-a}$ = 0.5°C/W
2
4
6
8
10
15
1.6
d.c.
1.75
a = 2.4
T_{mb} (°C)
131
153
175
$I_{F(AV)}$ (A)
T_{amb} (°C)

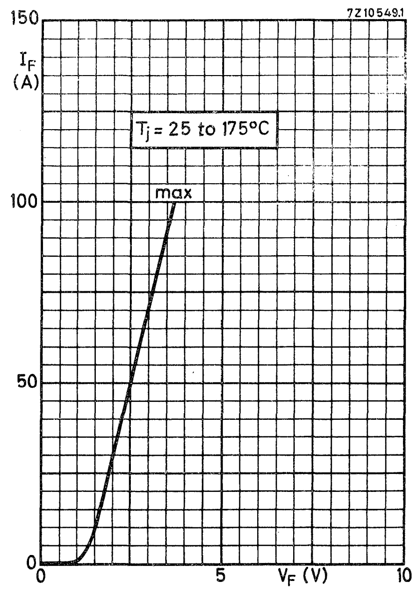

7Z10554.2
max. allowable non-repetitive peak reverse power dissipation in avalanche region versus duration
P_R
P_{RSM}
time
pulse duration
P_{RSM} (kW)
T_j = 25°C
75°C
125°C
150°C
175°C
pulse duration (ms)





ΔT = neccessary derating of $T_{j\,max}$ to accommodate repetitive transients in the reverse direction. Allowance can be made for this by assuming the ambient temperature ΔT higher.


7Z58894
400
300
200
100
0
$I_{FS(RMS)}$
(A)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 175°C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10


7Z10549.1
150
I_F
(A)
T_j = 25 to 175°C
max
100
50
0
0
5
V_F (V)
10

SILICON RECTIFIER DIODES

Diffused silicon rectifier diodes in a DO-4 metal envelope intended for power rectifier applications. The series consists of the following types.
Normal polarity (stud cathode): BYX42-300; BYX42-600; BYX42-900; BYX42-1200.
Reverse polarity (stud anode): BYX42-300R; BYX42-600R; BYX42-900R; BYX42-1200R.

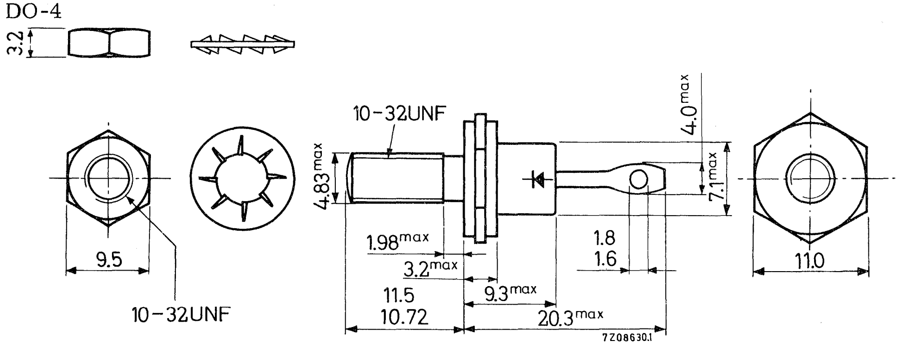
QUICK REFERENCE DATA

			BYX42-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Average forward current up to T_{mb} = 130 °C	I_{FAV}	max.	10				A
Junction temperature	T_j	max.	175				°C

MECHANICAL DATA

Dimensions in mm

DO-4



Net weight: 4.3 g
With accessories: 6.5 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295 (56262A)

Torque on nut: min. 8 cmkg
max. 17 cmkg
The mark shown applies to normal polarity types

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages

			BYX42-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	900	1200	V

Currents

Average forward current (averaged over any 20 ms period) T_{mb} = 130 °C	I_{FAV}	max.	10	A
Forward current (d.c.)	I_F	max.	16	A
Repetitive peak forward current	I_{FRM}	max.	60	A
Non repetitive peak forward current t = 10 ms (see page 3)	I_{FSM}	max.	125	A

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

Forward voltage at I_F = 15 A; T_j = 25 to 175 °C [2]	V_F	<	1.4	V
Reverse current at $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	200	μA

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:

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

[2] Measured under pulsed conditions to prevent excessive dissipation.

OPERATING NOTES (continued)

$\frac{V_{RSM}}{V_{RWM}}$	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

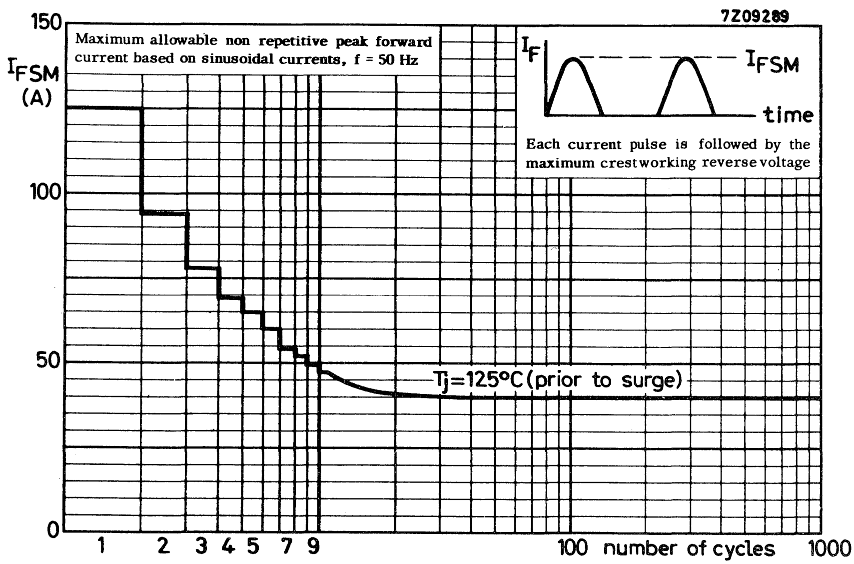
V_2 = transformer secondary r.m.s. voltage (V)

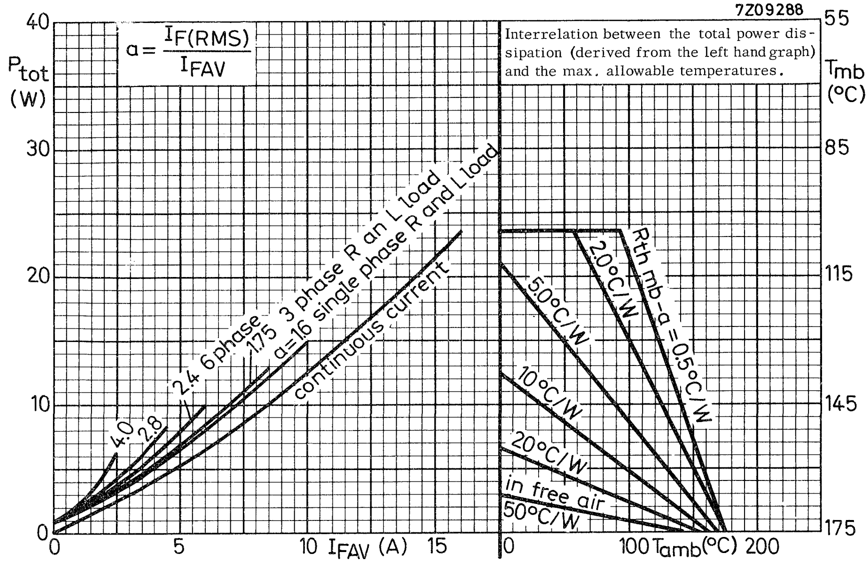
T = V_1/V_2

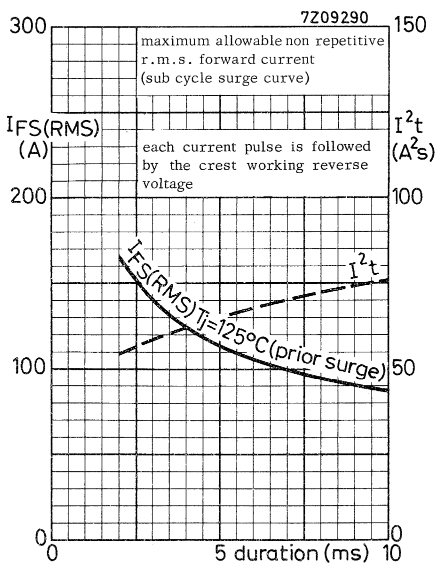
V_{RWM} stands for the actually applied crest working reverse voltage

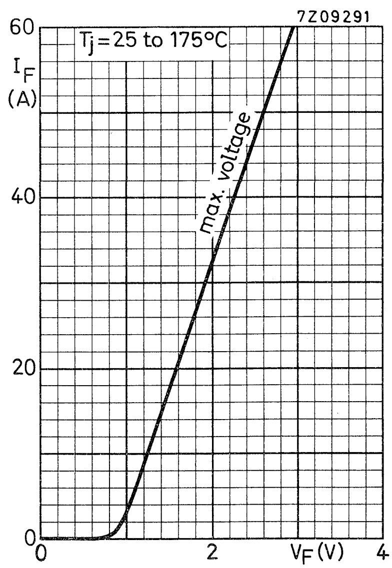
2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curve on page 4 a fast fuse is recommended.

3. The top connector should neither be bent nor twisted; 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.




7Z09288
$a = \frac{I_{F(RMS)}}{I_{FAV}}$
P_{tot} (W)
Interrelation between the total power dissipation (derived from the left hand graph) and the max. allowable temperatures.
T_{mb} (°C)
4.0
2.8
2.4 6 phase
1.75 3 phase R an L load
a=1.6 single phase R and L load
continuous current
$R_{th\ mb-a}$ = 0.5°C/W
2.0°C/W
5.0°C/W
10°C/W
20°C/W
in free air
50°C/W
I_{FAV} (A)
T_{amb}(°C)


7Z09290
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
each current pulse is followed by the crest working reverse voltage
$I_{FS(RMS)}$ (A)
I^2t (A^2s)
$I_{FS(RMS)}$ T_j=125°C (prior surge)
I^2t
duration (ms)


7Z09291
T_j=25 to 175°C
I_F (A)
max. voltage
V_F (V)

CONTROLLED AVALANCHE RECTIFIER DIODES

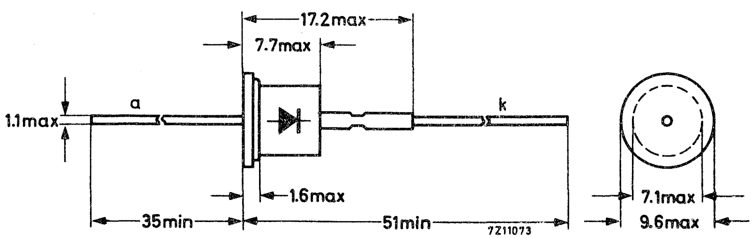
Diffused silicon diodes in a DO-1 metal envelope, capable of absorbing transients. They are intended for rectifier applications and particularly suited for series operation.
The series consists of the following reverse polarity types (anode to case): BYX45-600R, BYX45-800R, BYX45-1000R.

QUICK REFERENCE DATA

			BYX45-600R	800R	1000R	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Reverse breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	V
Average forward current	I_{FAV}	max.		1.5		A
Non repetitive peak forward current t = 10 ms; T_j = 150 °C (prior to surge)	I_{FSM}	max.		40		A
Non repetitive peak reverse power t = 10 µs; T_j = 25 °C	P_{RSM}	max.		2.5		kW
Junction temperature	T_j	max.		150		°C

MECHANICAL DATA Dimensions in mm

DO-1



All information applies to frequencies up to 400 Hz

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

Voltages

			BYX45-600R	800R	1000R	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period) (see also page 5)	I_{FAV}	max.	1.5	A
Forward current (d.c.)	I_F	max.	2.0	A
R.M.S. forward current	$I_{F(RMS)}$	max.	2.4	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Non repetitive peak forward current $t = 10$ ms; $T_j = 150$ °C (prior to surge)	I_{FSM}	max.	40	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	8	A^2s

Reverse power dissipation

Repetitive peak reverse power dissipation (square wave) $f = 50$ Hz; $t = 10$ µs; $T_j = 125$ °C	P_{RRM}	max.	800	W
Non repetitive peak reverse power dissipation (square wave) $t = 10$ µs; $T_j = 25$ °C (prior to surge)	P_{RSM}	max.	2.5	kW
$t = 10$ µs; $T_j = 150$ °C (prior to surge)	P_{RSM}	max.	800	W

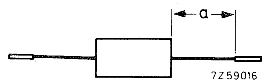
Temperatures

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

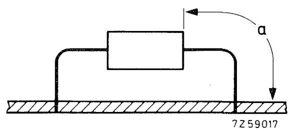
THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

The quoted values apply when no other leads run to the tie–points. If leads of other dissipating components share the same tie–points, the thermal resistance will be higher than that quoted.



1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 60 °C/W
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 70 °C/W



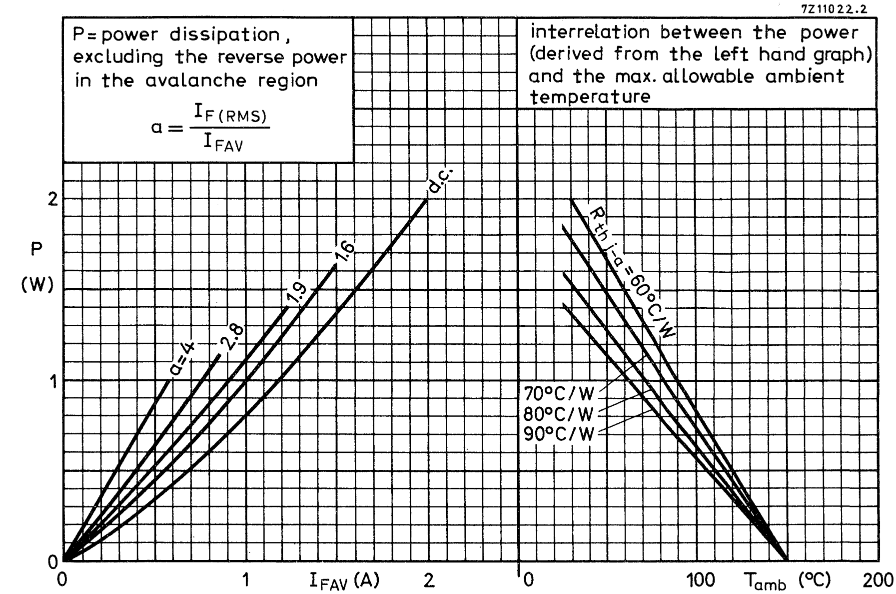
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 80 °C/W
4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 90 °C/W

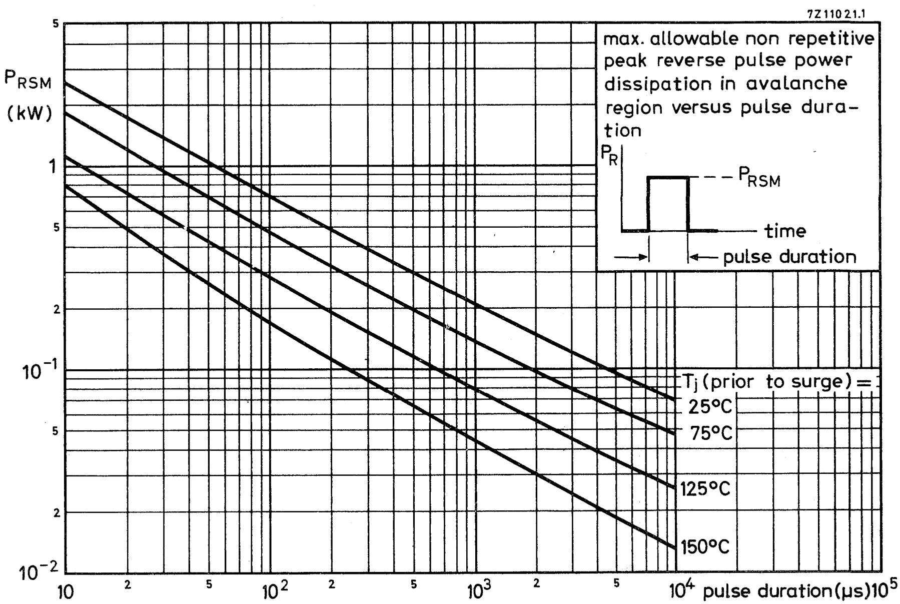
SOLDERING AND MOUNTING NOTES

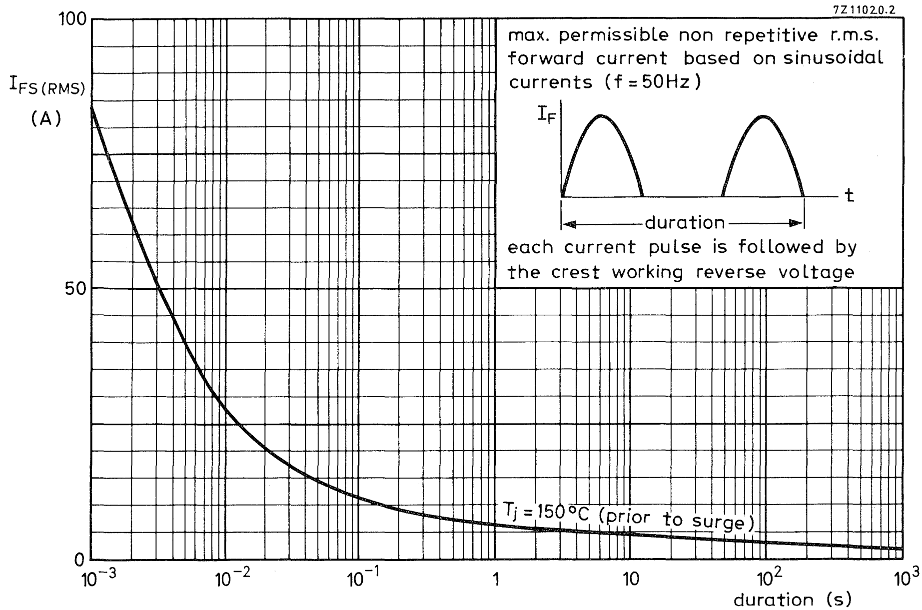
1. At a soldering iron or bath temperature of up to 245 °C, the maximum permissible soldering time is 10 s if the joint is 5 mm from the seal, 3 s if it is 1.5 mm from the seal.
2. At a temperature between 245 °C and 400 °C (max.), the joint must be more than 5 mm from the seal and soldering time must not exceed 5 s.
3. Leads should not be bent less than 1.5 mm from the seal; excert no axial pull when bending.

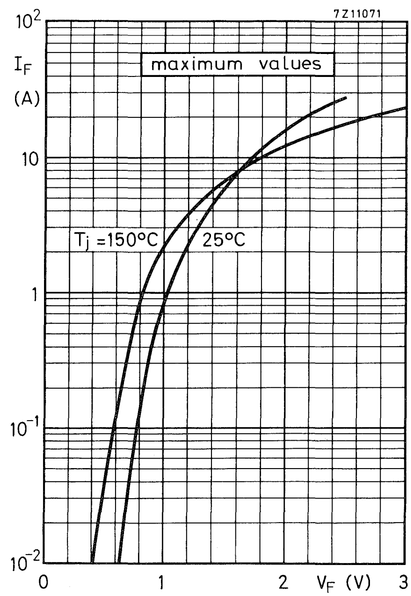
CHARACTERISTICS

			BYX45-600R	800R	1000R	
Voltages						
Forward voltage at I_F = 5 A; T_j = 25 °C	V_F	<	1.45	1.45	1.45	V
Reverse avalanche breakdown voltage I_R = 1 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V
		<	2000	2000	2000	V
Current						
Peak reverse current at T_j = 125 °C V_R = V_{RWMmax}	I_{RM}	<	100	100	100	μA


7Z11022.2
P = power dissipation, excluding the reverse power in the avalanche region
$a = \frac{I_{F(RMS)}}{I_{FAV}}$
P (W)
I_{FAV} (A)
a=4
2.8
1.9
1.6
d.c.
interrelation between the power (derived from the left hand graph) and the max. allowable ambient temperature
$R_{th\,j-a}$ = 60°C/W
70°C/W
80°C/W
90°C/W
T_{amb} (°C)


7Z11021.1
P_{RSM} (kW)
max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus pulse duration
P_R
P_{RSM}
time
pulse duration
T_j (prior to surge) =
25°C
75°C
125°C
150°C
pulse duration (μs)


7Z11020.2
100
$I_{FS(RMS)}$
(A)
50
0
max. permissible non repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
t
duration
each current pulse is followed by the crest working reverse voltage
T_j = 150 °C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
duration (s)


7Z11071
10^2
I_F
(A)
maximum values
10
1
10^{-1}
10^{-2}
T_j =150°C
25°C
0
1
2
V_F (V)
3

FAST RECOVERY RECTIFIER 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: BYX46-200 to BYX46-600
Reverse polarity: BYX46-200(R) to BYX46-600(R)

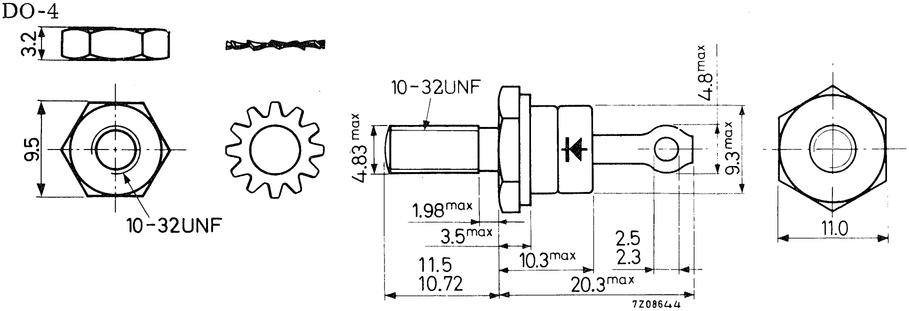
QUICK REFERENCE DATA

			BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Average forward current at $T_{mb} = 100\ ^{o}C$	I_{FAV}	max.	22					A
$T_{mb} = 125\ ^{o}C$	I_{FAV}	max.	15					A
Non repetitive peak forward current; t = 10 ms	I_{FSM}	max.	300					A
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3					$^{o}C/W$
Recovered charge $I_F = I_R = 2$ A	Q_s	<	0.7					μC

MECHANICAL DATA

Dimensions in mm

DO-4



Net weight : 5.6 g
With accessories: 7.8 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295, (56262A)

Torque on nut: min. 9 cm kg
max. 17 cm kg
The mark shown applies to normal polarity types.

All information applies to frequencies up to 50 kHz

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

Voltage

		BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max. 200	300	400	500	600	V

Currents

Average forward current (averaged over any 20 ms period) at T_{mb} = 100 °C	I_{FAV}	max.	22	A
at T_{mb} = 125 °C	I_{FAV}	max.	15	A
Forward current (d.c.)	I_F	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	400	A
Non repetitive peak forward current t = 10 ms (see also page 7)	I_{FSM}	max.	300	A
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	25	A

Reverse power dissipation

Repetitive peak reverse power at f = 50 Hz square wave; t = 10 μs; T_j = 100 °C	P_{RRM}	max.	9.5	kW
Non repetitive peak reverse power (square wave) See also page 6) t = 10 μs; T_j = 25 °C	P_{RSM}	max.	18	kW
T_j = 165 °C	P_{RSM}	max.	4	kW

Temperatures

Storage temperature	T_{stg}		−55 to +165	°C
Junction temperature	T_j	max.	165	°C

THERMAL RESISTANCE

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

CHARACTERISTICS

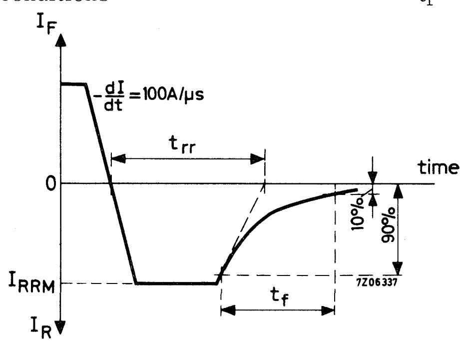
T_j = 25 °C unless otherwise specified

		BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Forward voltage at I_F = 50 A	V_F	< 2.0	2.0	2.0	2.0	2.0	V
Reverse breakdown voltage I_R = 5 mA; see page 9)	$V_{(BR)R}$	> 250	375	500	625	750	V
		< 1050	1050	1050	1050	1050	V
Reverse current at T_j = 125 °C $V_R = V_{RWMmax}$.	I_R	< 4.0	4.0	4.0	4.0	4.0	mA

Recovered charge when switched from
I_F = 2 A to V_R = 30 V;
I_R limited to I_{RRM} = 2 A; $-\frac{dI}{dt}$ = 100 A/μs — Q_s < 0.70 μC

Reverse recovery time when switched from
I_F = 2 A to V_R = 30 V;
I_R limited to I_{RRM} = 2 A; $-\frac{dI}{dt}$ = 100 A/μs — t_{rr} < 0.35 μs

Fall time under all conditions — t_f < 0.30 μs



OPERATING NOTES FOR (See also general pages at the beginning of this section.)

1. Square wave operation
When I_F has been flowing sufficiently long for the steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during t_f as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graphs on page 11)

p.t.o.

OPERATING NOTES (continued)

2. Sine wave operation

Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of I_{RRM}), so that power loss due to reverse recovery may be safely ignored for frequencies up to 50 kHz.

3. Determination of the heatsink thermal resistance

Example:

Assume a diode, used in an inverter.

frequency	f	=	20	kHz
duty cycle	δ	=	0.5	
ambient temperature	T_{amb}	=	40	°C
switched from	I_F	=	12	A
to	V_R	=	300	V
at a rate	$-\frac{dI}{dt}$	=	50	A/µs

At a duty cycle $\delta = 0.5$ the average forward current $I_{FAV} = 6$ A.
From the upper graph on page 5 it follows, that at $I_{FAV} = 6$ A the average forward power + average leakage power = 13 W (point A).
The additional power losses due to switching-off can be read from the nomogram on page 10 (the example being based on optimum use, i.e. $T_j = 165$ °C). Starting from $I_F = 12$ A on the horizontal scale trace upwards until the appropriate line $-\frac{dI}{dt} = 50$ A/µs. From the intersection trace horizontally to the right until the line for f = 20 kHz. Then trace downwards to the line $V_R = 300$ V and ultimately trace horizontally to the left and on the vertical axis read the additional average power dissipation $P_{RAV} = 6$ W.
Therefore the total power dissipation $P_{tot} = 13\ \text{W} + 6\ \text{W} = 19\ \text{W}$ (point B of the upper graph on page 5).

From the right hand part of the upper graph on page 5 follows the thermal resistance, required at $T_{amb} = 40$ °C.

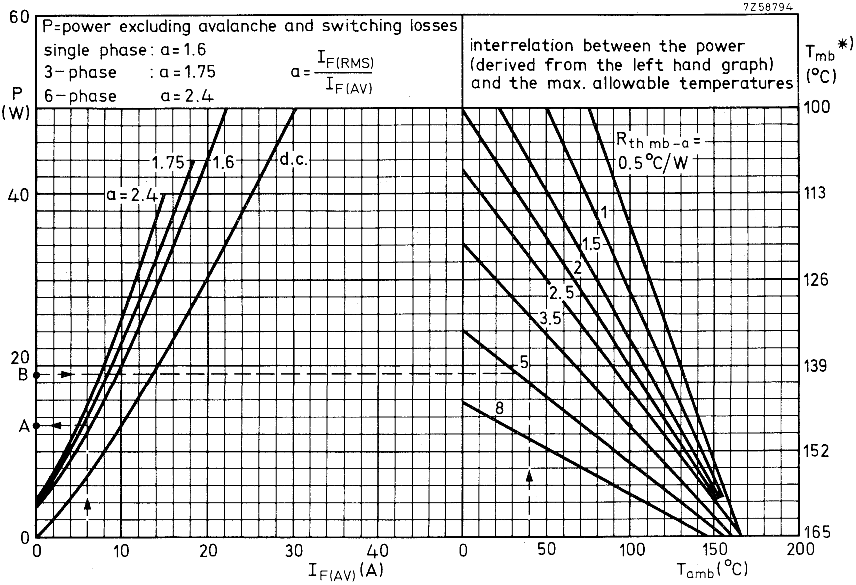
$$R_{th\ mb\text{-}a} \approx 5\ ^{\circ}\text{C/W}$$

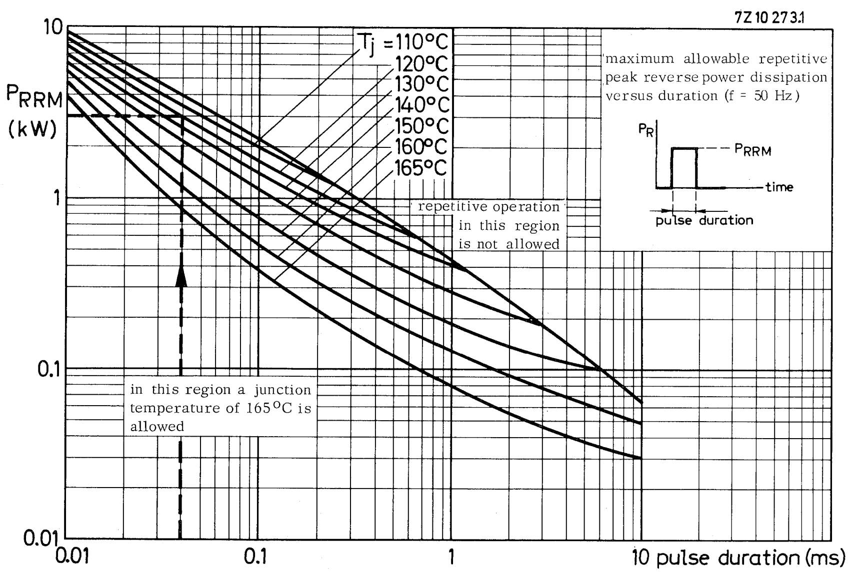
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.5$ °C/W.

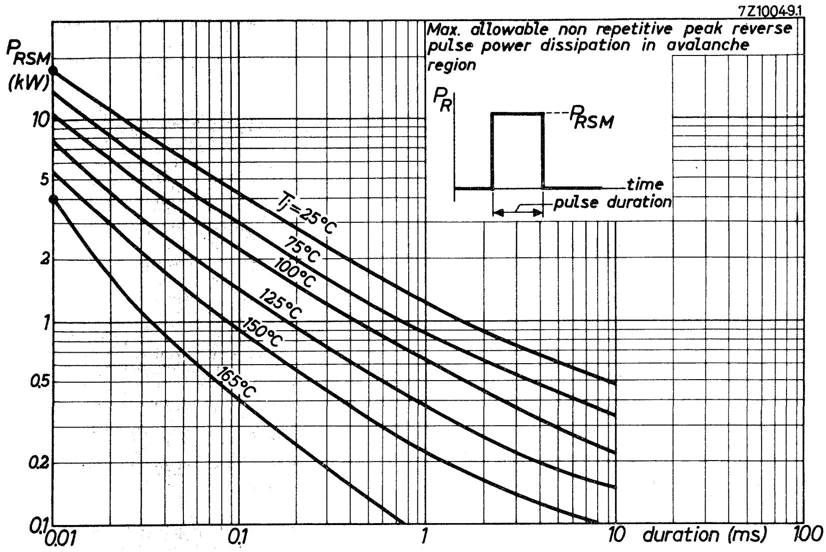
Hence the heatsink thermal resistance should be:

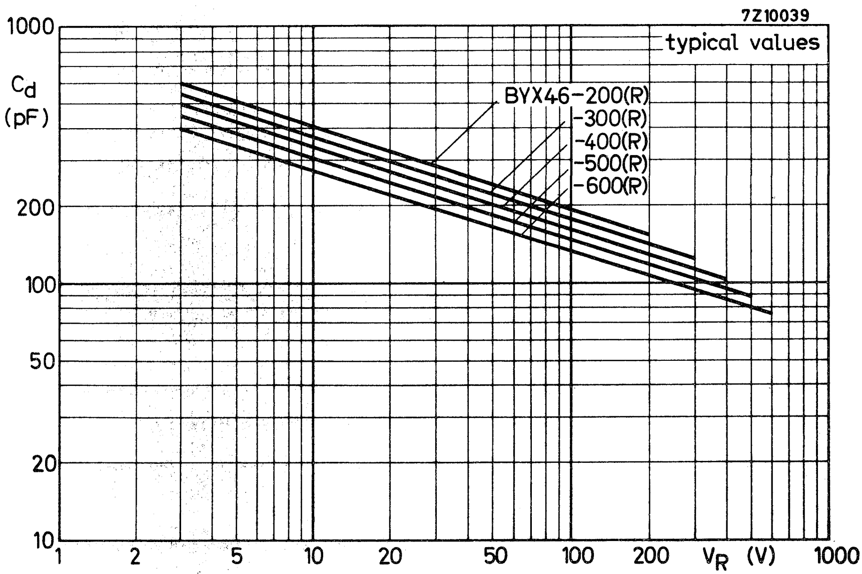
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (5 - 0.5)\ ^{\circ}\text{C/W} = 4.5\ ^{\circ}\text{C/W}.$$

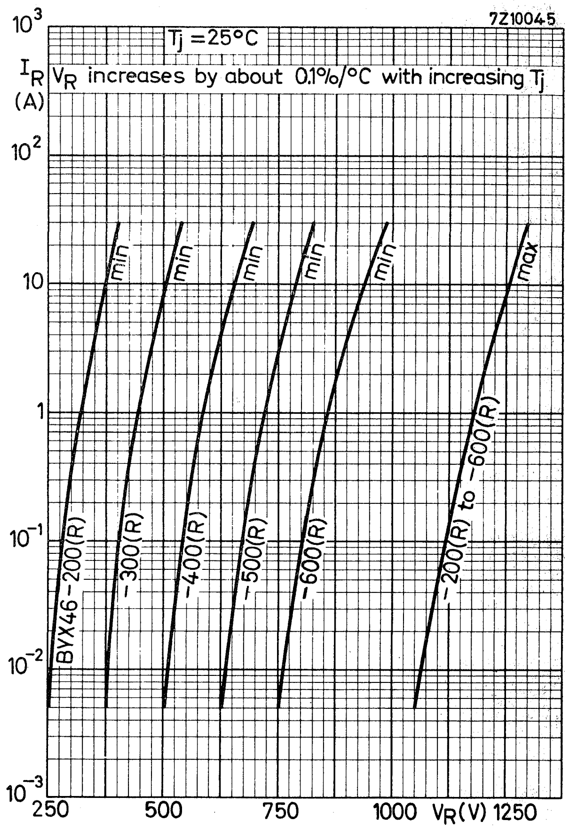
The applicable heatsink(s) may then be found in the Section HEATSINKS.

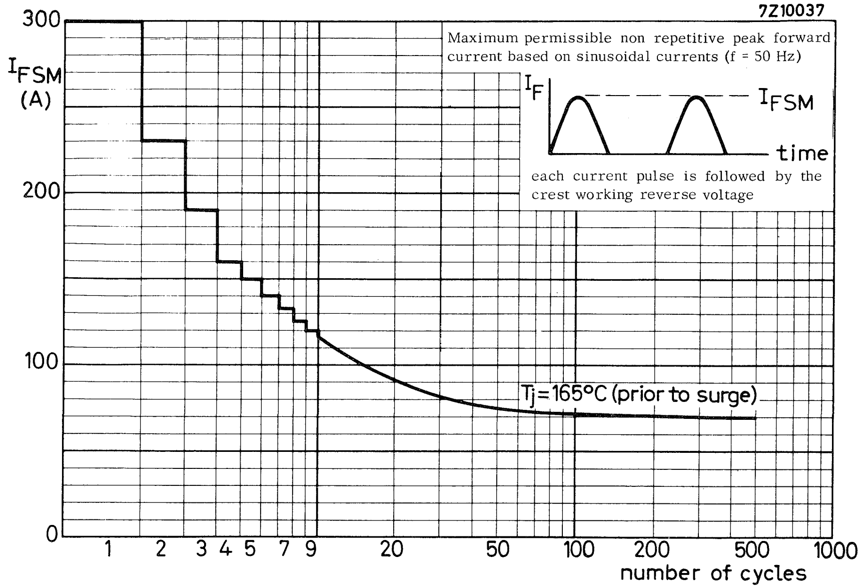

7Z58794
P=power excluding avalanche and switching losses
single phase: a=1.6
3-phase : a=1.75
6-phase a=2.4
a = IF(RMS) / IF(AV)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
Tmb *) (°C)
Rth mb-a = 0.5°C/W
1
1.5
2
2.5
3.5
5
8
1.75
1.6
d.c.
a=2.4
B
A
IF(AV) (A)
Tamb (°C)

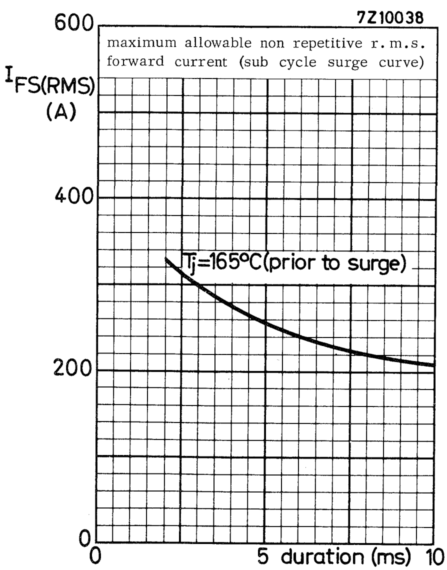

7Z10273.1
PRRM (kW)
Tj =110°C
120°C
130°C
140°C
150°C
160°C
165°C
maximum allowable repetitive peak reverse power dissipation versus duration (f = 50 Hz)
PR
PRRM
time
pulse duration
repetitive operation in this region is not allowed
in this region a junction temperature of 165°C is allowed
pulse duration (ms)

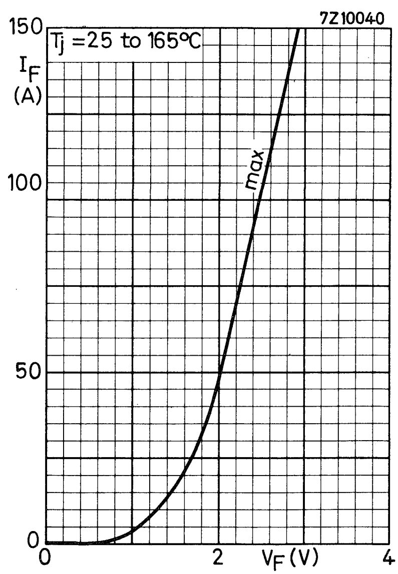

7Z10049.1
Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region
P_{RSM} (kW)
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
T_j=25°C
75°C
100°C
125°C
150°C
165°C
P_R
P_{RSM}
time
pulse duration

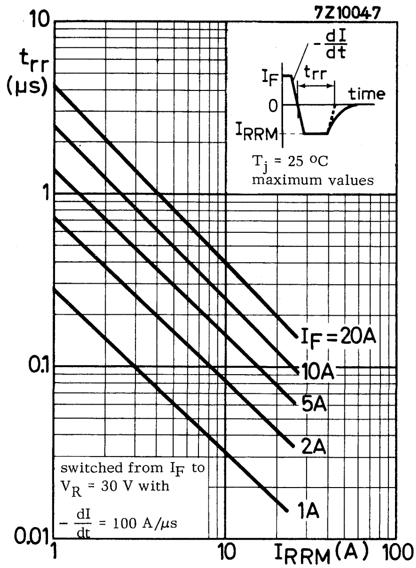

7Z10039
typical values
C_d (pF)
1000
200
100
50
20
10
1
2
5
10
20
50
100
200
V_R (V)
1000
BYX46-200(R)
-300(R)
-400(R)
-500(R)
-600(R)

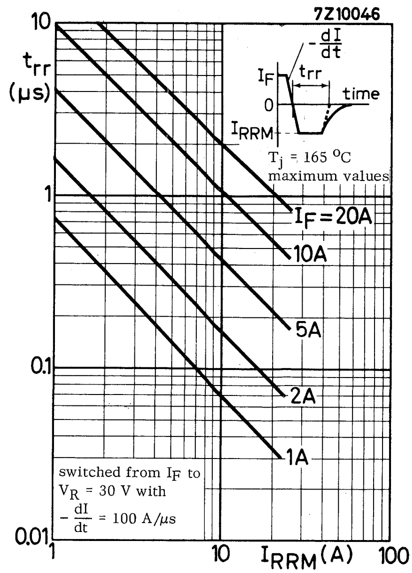

7Z10045
10^3
I_R (A)
$T_j = 25°C$
V_R increases by about 0.1%/°C with increasing T_j
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
250
500
750
1000
V_R(V)
1250
min
min
min
min
min
max
BYX46-200(R)
-300(R)
-400(R)
-500(R)
-600(R)
-200(R) to -600(R)

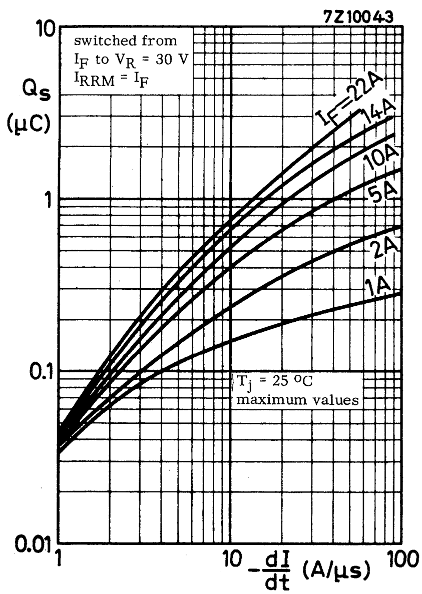

7Z10037
Maximum permissible non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
T_j=165°C (prior to surge)
I_{FSM} (A)
300
200
100
0
1 2 3 4 5 7 9 20 50 100 200 500 1000
number of cycles

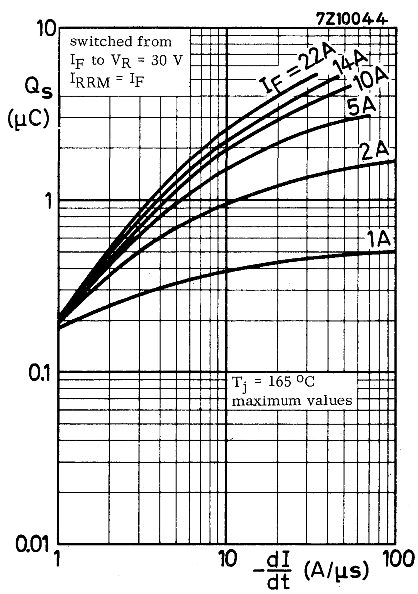

7Z10038
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
T_j=165°C(prior to surge)
$I_{FS(RMS)}$ (A)
600
400
200
0
0
5 duration (ms) 10

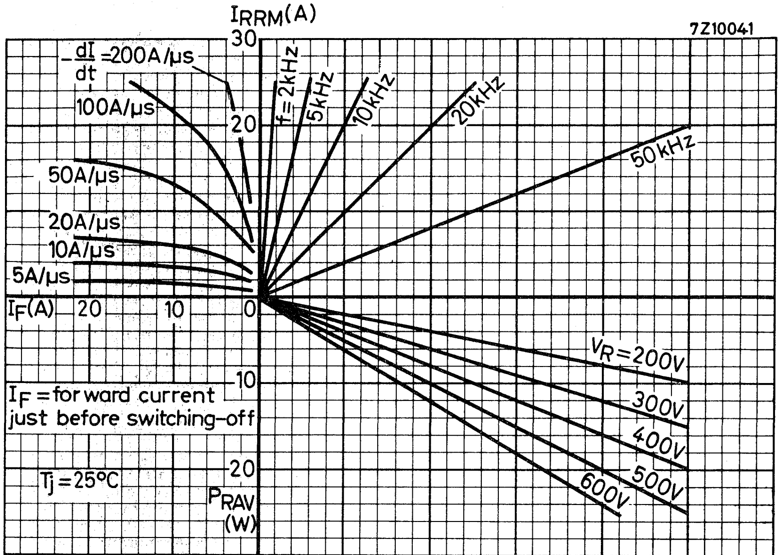

7Z10040
T_j =25 to 165°C
I_F (A)
150
100
50
0
max
0
2 V_F (V) 4

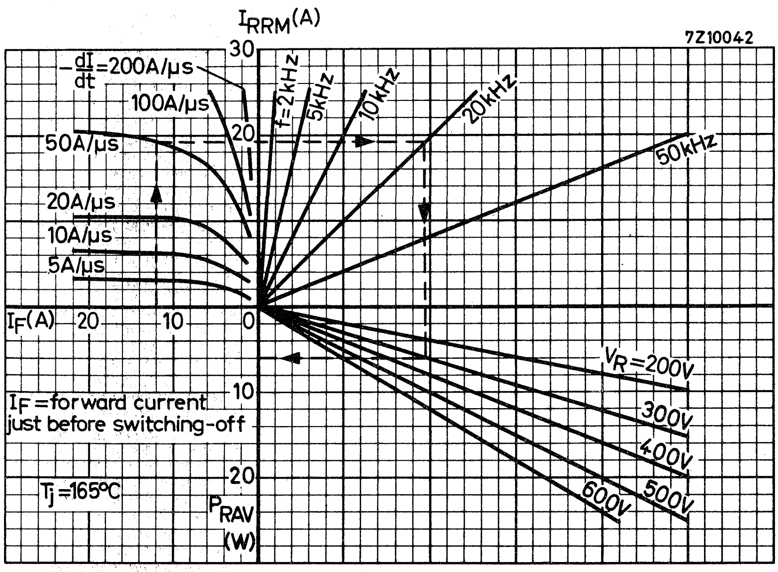

7Z10047
t_{rr} (µs)
$-\frac{dI}{dt}$
I_F
t_{rr}
time
I_{RRM}
T_j = 25 °C
maximum values
I_F = 20A
10A
5A
2A
1A
switched from I_F to V_R = 30 V with $-\frac{dI}{dt}$ = 100 A/µs
I_{RRM} (A)


7Z10046
t_{rr} (µs)
$-\frac{dI}{dt}$
I_F
t_{rr}
time
I_{RRM}
T_j = 165 °C
maximum values
I_F = 20A
10A
5A
2A
1A
switched from I_F to V_R = 30 V with $-\frac{dI}{dt}$ = 100 A/µs
I_{RRM} (A)


7Z10043
Q_s (µC)
switched from I_F to V_R = 30 V I_{RRM} = I_F
I_F = 22A
14A
10A
5A
2A
1A
T_j = 25 °C
maximum values
$-\frac{dI}{dt}$ (A/µs)


7Z10044
Q_s (µC)
switched from I_F to V_R = 30 V I_{RRM} = I_F
I_F = 22A
14A
10A
5A
2A
1A
T_j = 165 °C
maximum values
$-\frac{dI}{dt}$ (A/µs)





Nomogram: Power loss P_{RAV} due to switching only (square wave operation)

SILICON RECTIFIER DIODES

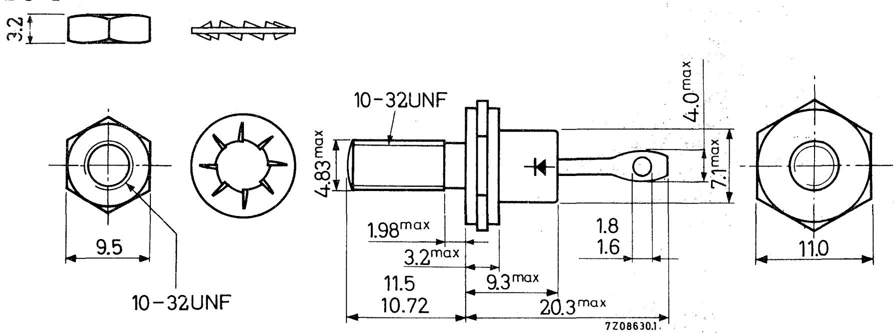
Diffused silicon rectifier diodes in a DO-4 metal envelope intended for power rectifier applications. The series consists of the following types.
Normal polarity (stud cathode): BYX48-300; BYX48-600; BYX48-900; BYX48-1200.
Reverse polarity (stud anode): BYX48-300R; BYX48-600R; BYX48-900R; BYX48-1200R.

QUICK REFERENCE DATA

			BYX48-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Average forward current up to T_{mb} = 130 °C	I_{FAV}	max.	6.0				A
Junction temperature	T_j	max.	175				°C

MECHANICAL DATA Dimensions in mm

DO-4



Net weight : 4.3 g
With accessories: 6.5 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295 (56262A)

Torque on nut: min. 8 cmkg
max. 17 cmkg
The mark shown applies to normal polarity types

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages		BYX48-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max. 200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max. 300	600	900	1200	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max. 300	600	900	1200	V

Currents

Average forward current (averaged over any 20 ms period) T_{mb} = 130 °C	I_{FAV}	max.	6.0	A
Forward current (d.c.)	I_F	max.	9.5	A
Repetitive peak forward current	I_{FRM}	max.	36	A
Non repetitive peak forward current t = 10 ms (see page 3)	I_{FSM}	max.	90	A

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j-mb}$	=	4.5	°C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.5	°C/W

CHARACTERISTICS

Forward voltage at I_F = 15 A; T_j = 25 to 175 °C [2]	V_F	< 1.8	V
Reverse current at $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	< 200	μA

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:

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.
[2]) Measured under pulsed conditions to prevent excessive dissipation.

OPERATING NOTES (continued)

$\frac{V_{RSM}}{V_{RWM}}$	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)

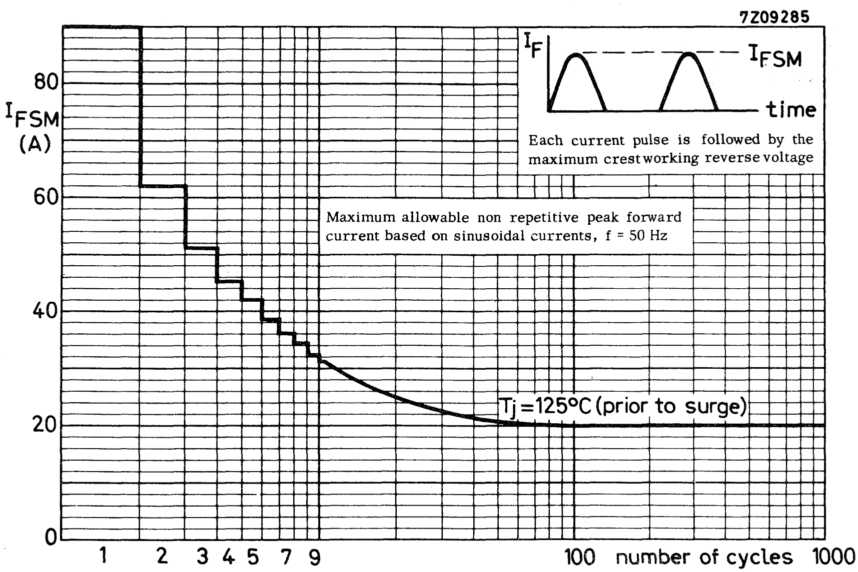
V_2 = transformer secondary r.m.s. voltage (V)

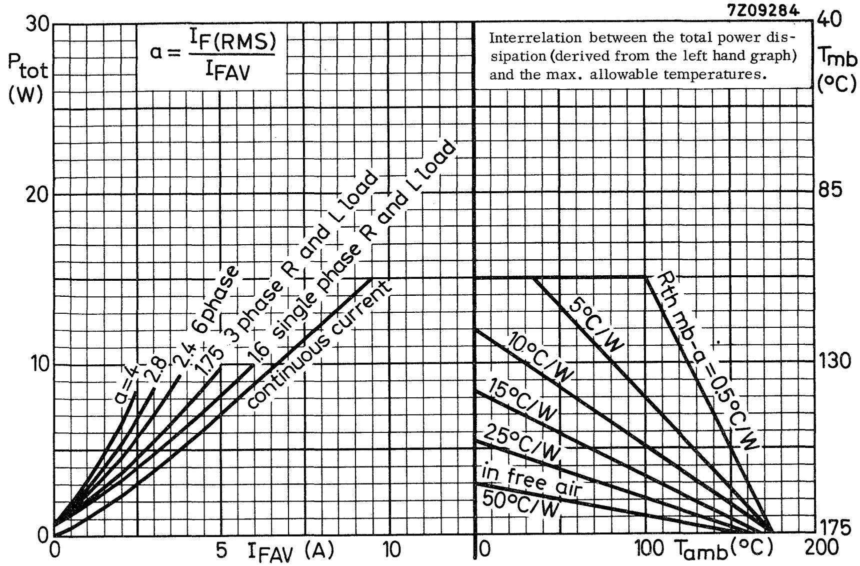
T = V_1/V_2

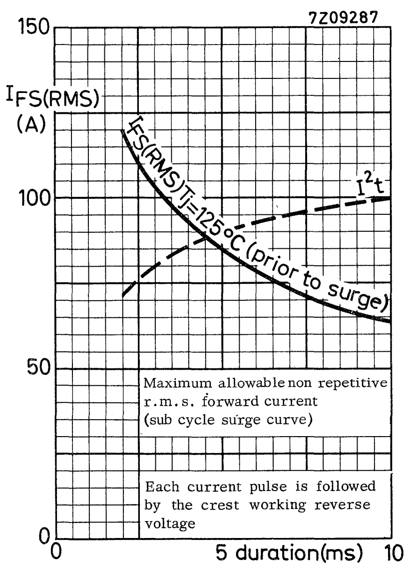
V_{RWM} stands for the actually applied crest working reverse voltage

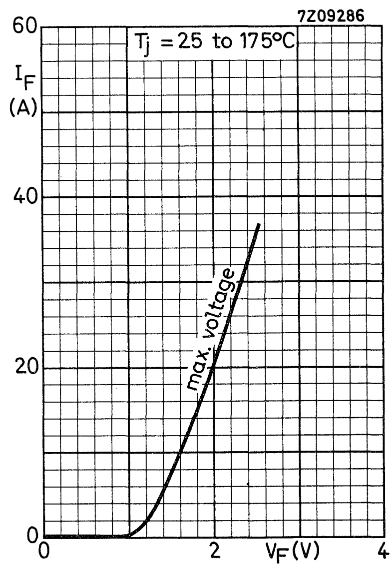
2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves on page 4 a fast fuse is recommended.

3. The top connector should neither be bent nor twisted; 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.




7Z09284
30
Ptot
(W)
20
10
0
$a = \frac{I_{F(RMS)}}{I_{FAV}}$
a=4
2.8
2.4 6phase
1.75 3 phase R and L load
1.6 single phase R and L load
continuous current
0
5 IFAV (A)
10
Interrelation between the total power dissipation (derived from the left hand graph) and the max. allowable temperatures.
5°C/W
10°C/W
15°C/W
25°C/W
in free air
50°C/W
Rth mb-a = 0.5°C/W
0
100 Tamb (°C)
200
40
Tmb
(°C)
85
130
175


7Z09287
150
IFS(RMS)
(A)
100
50
0
IFS(RMS) Tj=125°C (prior to surge)
I²t
Maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
Each current pulse is followed by the crest working reverse voltage
0
5 duration(ms)
10


7Z09286
60
IF
(A)
40
20
0
Tj = 25 to 175°C
max. voltage
0
2
VF (V)
4

FAST RECOVERY RECTIFIER DIODES

Diffused silicon diodes in a DO-4 metal envelope, 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 (cathode to stud): BYX50-200 to BYX50-600
Reverse polarity (anode to stud): BYX50-200R to BYX50-600R.

QUICK REFERENCE DATA

			BYX50-200(R)	300(R)	400(R)	500(R)	600(R)
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	500	600

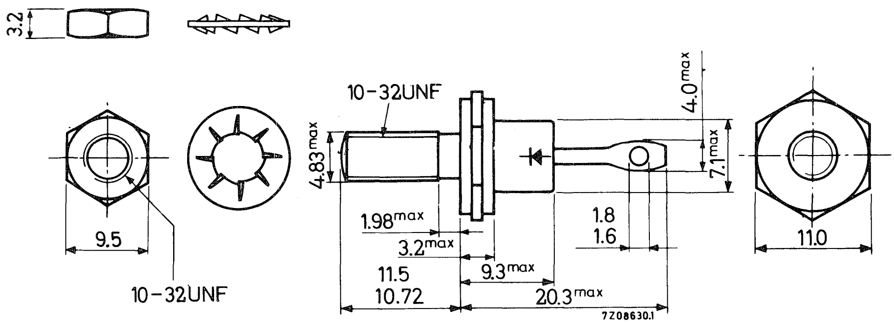
Average forward current up to T_{mb} = 110 °C	I_{FAV}	max.	6	A
at T_{mb} = 125 °C	I_{FAV}	max.	4	A
Non repetitive peak forward current t = 10 ms; T_j = 150 °C (prior to surge)	I_{FSM}	max.	80	A
Junction temperature	T_j	max.	150	°C
Reverse recovery charge at T_j = 25 °C; I_F = 4 A; $-\frac{dI}{dt}$ = 4 A/μs	Q_s	max.	250	nC

MECHANICAL DATA see page 2

MECHANICAL DATA

Dimensions in mm

DO-4



Net weight: 6.5 g

Torque on nut: min. 8 kg cm
(0.8 Newton metres)
max. 17 kg cm
(1.7 Newton metres)

The mark shown applies to the normal polarity type

Diameter of clearance hole: max. 5.2 mm
Accessories available: 56295

All information applies to frequencies up to 50 kHz

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

Voltages [1]			200(R)	300(R)	400 (R)	500 (R)	600(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.	200	300	400	500	600	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	250	350	450	550	650	V

[1]) To ensure thermal stability: $R_{th\ j\text{-}a} \leq 6.5\,^{o}C/W$ (d.c.) or $\leq 13\,^{o}C/W$ (a.c.).
For smaller heatsinks $T_{j\ max}$ should be derated (see page 4 upper graph)

RATINGS (continued)

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 110 ^oC	I_{FAV}	max.	6	A
at T_{mb} = 125 ^oC	I_{FAV}	max.	4	A
Forward current (d.c.)	I_F	max.	10	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	40	A
Non repetitive peak forward current t = 10 ms ; T_j = 150 ^oC (prior to surge)	I_{FSM}	max.	80	A
I squared t for fusing (t = 10 ms)	I^2t	max.	32	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	10	A

Temperatures

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

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	$^oC/W$
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.5	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	$^oC/W$
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	1	$^oC/W$

CHARACTERISTICS

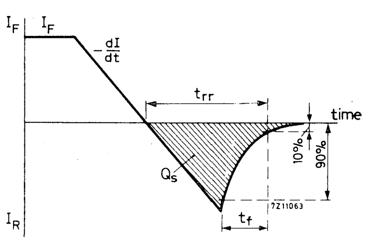
Forward voltage at I_F = 20 A; T_j = 25 ^oC	V_F	<	1.95	V
Peak reverse current at T_j = 125 ^oC; $V_R = V_{RWMmax}$	I_{RM}	<	1.4	mA

Reverse recovery when switched from

I_F = 1 A to $V_R \geq$ 30 V with $-\frac{dI}{dt}$ = 100 A/μs; T_j = 150 ^oC	t_{rr}	<	200	ns

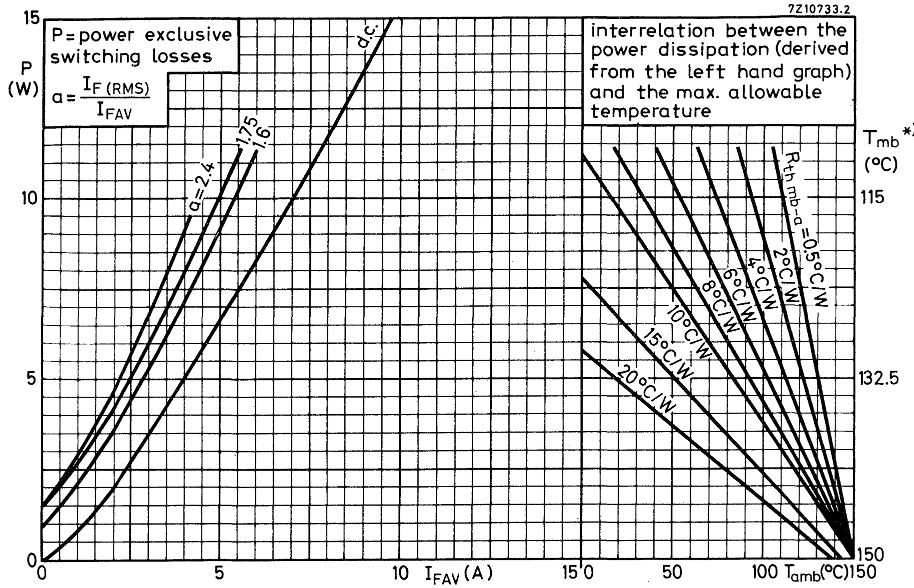
I_F = 4 A to $V_R \geq$ 30 V with $-\frac{dI}{dt}$ = 4 A/μs; T_j = 25 ^oC

Recovery charge	Q_s	<	250	nC
Recovery time	t_{rr}	<	500	ns
Fall time	t_f	<	250	ns

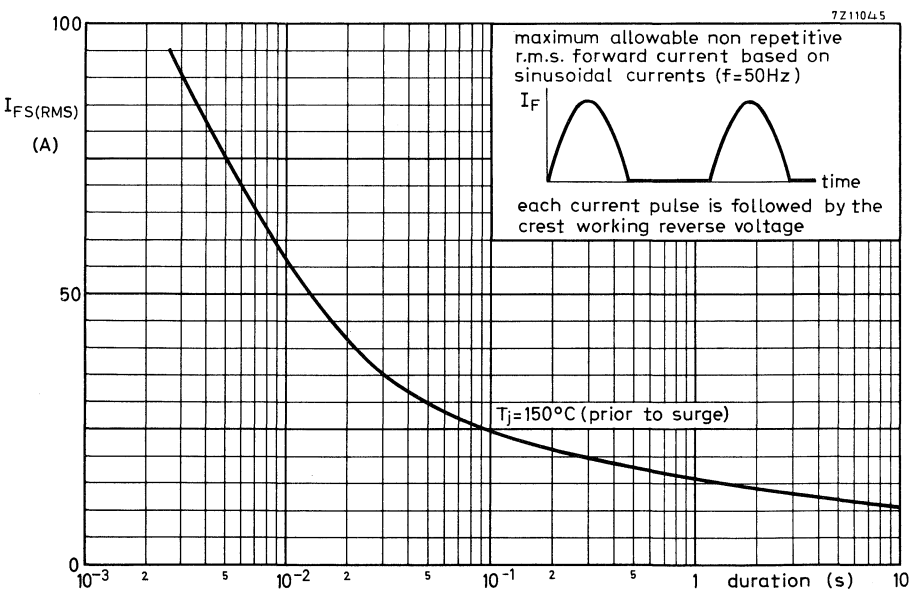


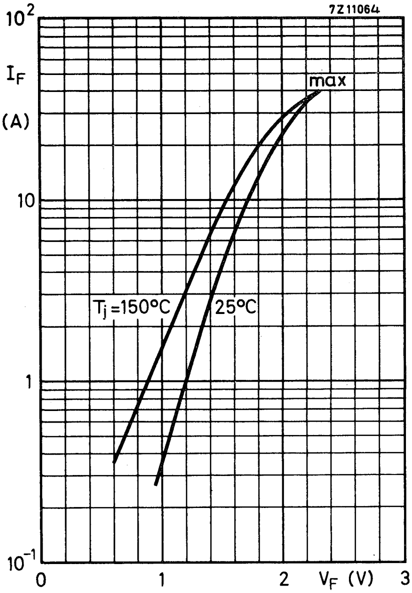
APPLICATION INFORMATION AND OPERATING NOTES

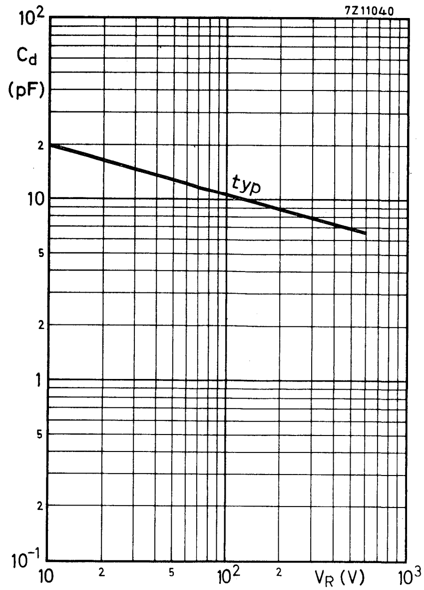
See general pages at the beginning of this section

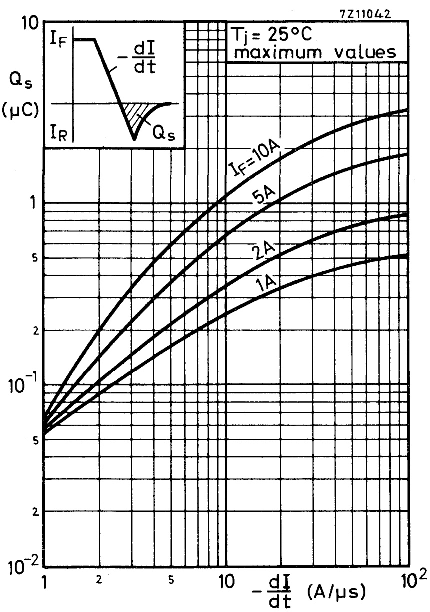


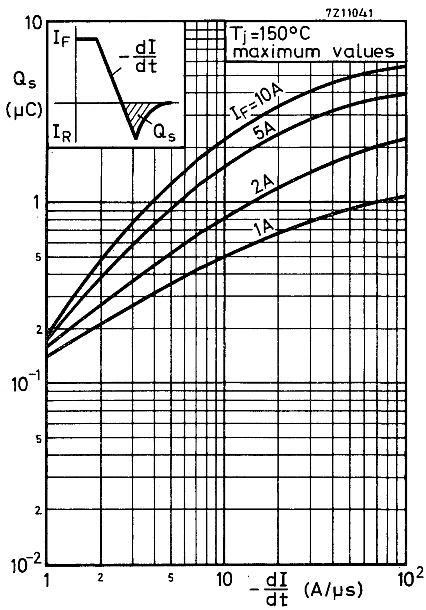
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\,mb-a} \lesssim 9.5\,°C/W$

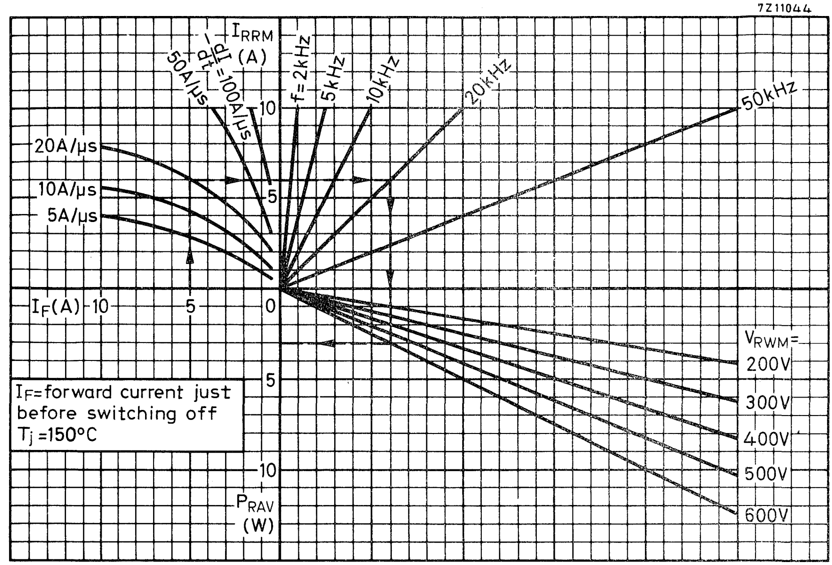



7Z11064
10^2
I_F
(A)
max
10
T_j =150°C
25°C
1
10^{-1}
0
1
2
V_F (V)
3

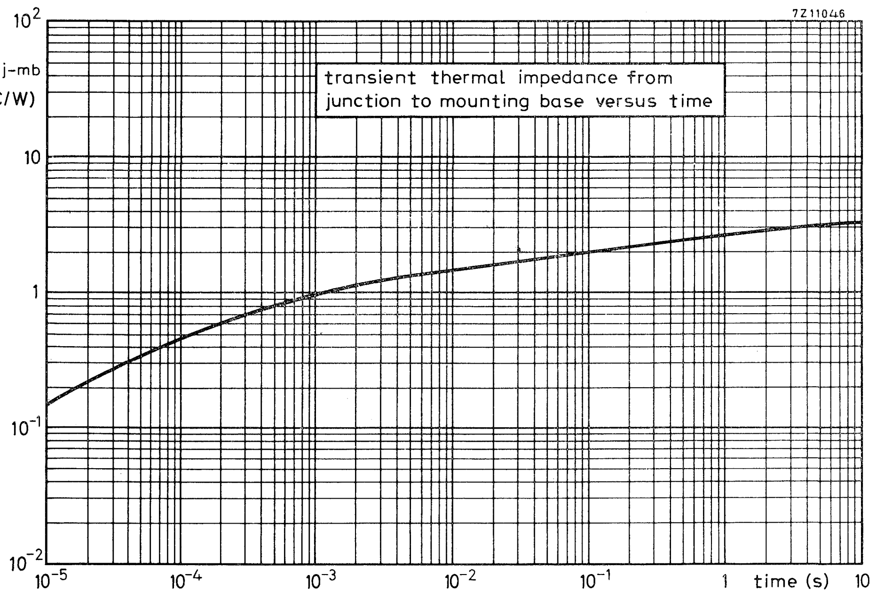

7Z11040
10^2
C_d
(pF)
typ
10
1
10^{-1}
10
10^2
V_R (V)
10^3

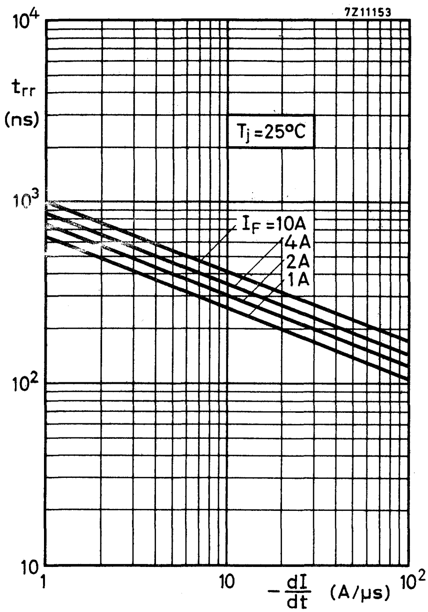

7Z11042
T_j = 25°C
maximum values
Q_s
(μC)
I_F
I_R
$-\frac{dI}{dt}$
I_F=10A
5A
2A
1A
10
1
10^{-1}
10^{-2}
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2

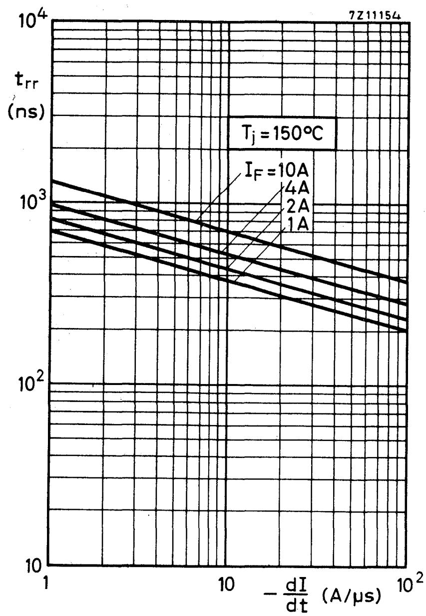

7Z11041
T_j =150°C
maximum values
Q_s
(μC)
I_F
I_R
$-\frac{dI}{dt}$
I_F=10A
5A
2A
1A
10
1
10^{-1}
10^{-2}
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2



Nomogram: Power loss P_{RAV} due to switching only (square wave operation)




7Z11153
t_{rr}
(ns)
$T_j = 25°C$
$I_F = 10A$
4A
2A
1A
10^4
10^3
10^2
10
1
10
10^2
$-\frac{dI}{dt}$ (A/μs)

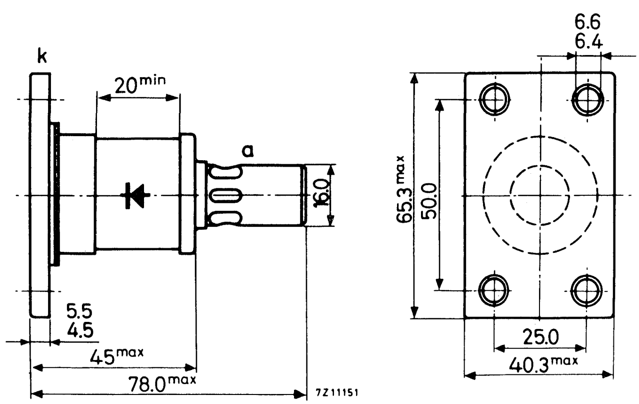

7Z11154
t_{rr}
(ns)
$T_j = 150°C$
$I_F = 10A$
4A
2A
1A
10^4
10^3
10^2
10
1
10
10^2
$-\frac{dI}{dt}$ (A/μs)

SILICON RECTIFIER DIODES

Diffused silicon diodes, with bevelled crystal, in metal envelopes with ceramic insulation, intended for power rectifier applications.
The series consists of the following types:
Normal polarity: (cathode to stud): BYX51-1200; -1600; -2000
Reverse polarity: (anode to stud) : BYX51-1200R; -1600R; -2000R

QUICK REFERENCE DATA

		BYX51-	1200(R)	1600(R)	2000(R)	
Crest working reverse voltage	V_{RWM}	max.	800	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	1200	1600	2000	V
Average forward current up to T_{mb} = 115 °C	I_{FAV}	max.	400			A
Non repetitive peak forward current (t = 10 ms) T_j = 190 °C prior to surge	I_{FSM}	max.	6000			A
Junction temperature	T_j	max.	190			°C



Net weight: 250 g
Normal polarity (cathode to stud, ⊣◀); blue circle on top
Reverse polarity (anode to stud, ▶⊢); red circle on top
Accessories and mounting instructions: see page 3.

All information applies to frequencies up to 400 Hz

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

Voltages [1]		BYX51-	1200(R)	1600(R)	2000(R)	
Continuous reverse voltage	V_R	max.	800	1200	1200	V
Crest working reverse voltage	V_{RWM}	max.	800	1200	1200	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	1200	1600	2000	V [2]
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	1200	1600	2000	V [2]

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 115 °C	I_{FAV}	max.	400	A
Forward current (d.c.)	I_F	max.	625	A
R.M.S. forward current	$I_{F(RMS)}$	max.	625	A
Repetitive peak forward current	I_{FRM}	max.	2000	A
Non repetitive peak forward current t = 10ms; half sine wave; T_j=190 °C prior to surge	I_{FSM}	max.	6000	A
I squared t for fusing (t = 10 ms)	I^2t	max.	180 000	A^2s
Intermittent operation	See page 7			

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.13	°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 (e.g. Dow Corning 340)	$R_{th\ mb\text{-}h}$	=	0.03	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.01	°C/W

[1]) To ensure thermal stability: $R_{th\ j\text{-}a} \leq 0.26$ °C/W (d.c.) or 0.52 °C/W (a.c.)

[2]) a. Derate this value with 0.15 %/°C below T_j = 25 °C
b. See "OPERATING NOTE" 2, on page 4.

CHARACTERISTICS

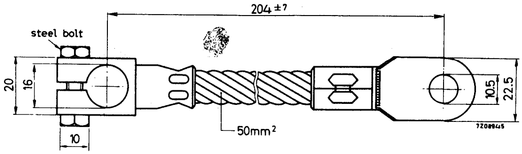
Forward voltage at I_F = 1250 A; T_j = 25 °C	V_F	< 1.5	V 1)
Peak reverse current at V_{RM} = V_{RWMmax} ; T_j = 175°C	I_{RM}	< 30	mA

ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

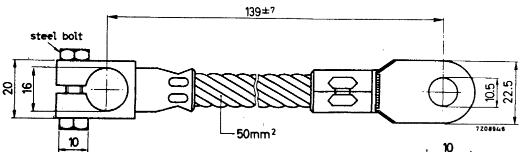
Flexible top lead

Type number 56243
Weight: 170 g



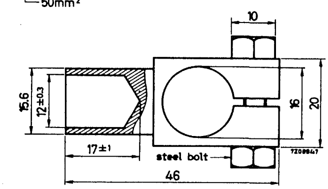
Flexible top lead

Type number 56243A
Weight: 140 g



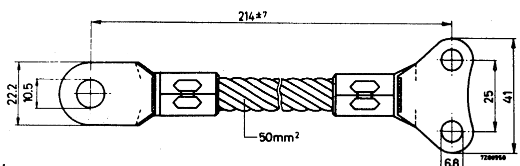
Clamp

Type number 56244
Weight: 70 g



Flexible base lead

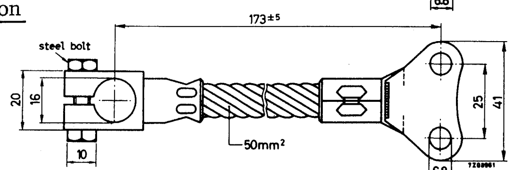
Type number 56247
Weight: 135 g



Flexible top lead for series connection

Type number 56296

Weight: 155 g



1. These accessories are **supplied** 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 kg cm (3 Newton-metres); max. 60 kg cm (6 Newton-metres)
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact: 30 kg cm (3 Newton-metres)
   Max. torque : 60 kg cm (6 Newton-metres)
4. Top lead 56243 should only be used for $I_{F(RMS)} \leq 400$ A
   Top lead 56243A is necessary for $I_{F(RMS)} > 400$ A to prevent excessive temperature of the top connection.

1) **Measured under pulsed conditions to avoid excessive dissipation.**

OPERATING NOTES (See also general pages at the beginning of this section)

1. The diode should be shunted by a 0.5 μF capacitor in series with a 10 Ω resistor (recovery phenomena).
   Leads should be as short as possible to keep the inductance to a minimum.

2. Parallel operation

   The nominal current rating of each diode must be derated by a factor d:

$$d = 0.8 + \frac{0.2}{n}$$

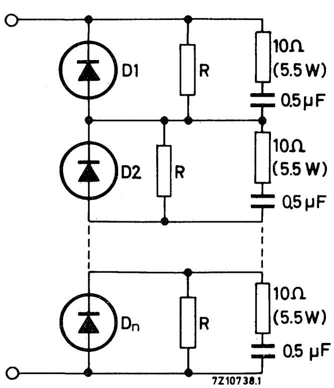
   in which n stands for the number of diodes to be connected in parallel. If fuses are connected in series with each diode, a less severe derating factor can be used:

$$d' = 0.85 + \frac{0.15}{n}$$

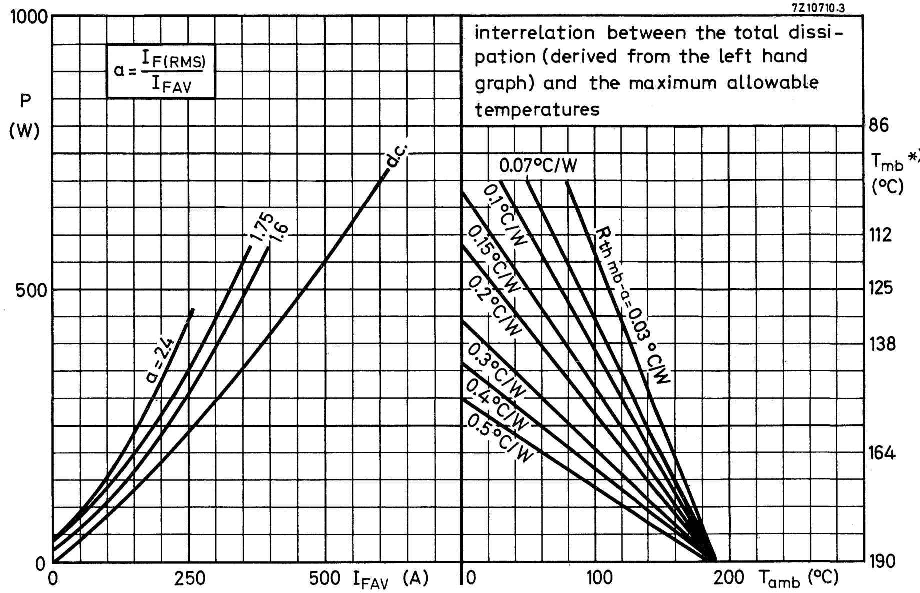
3. Series operation

For series connection the following elements are necessary:

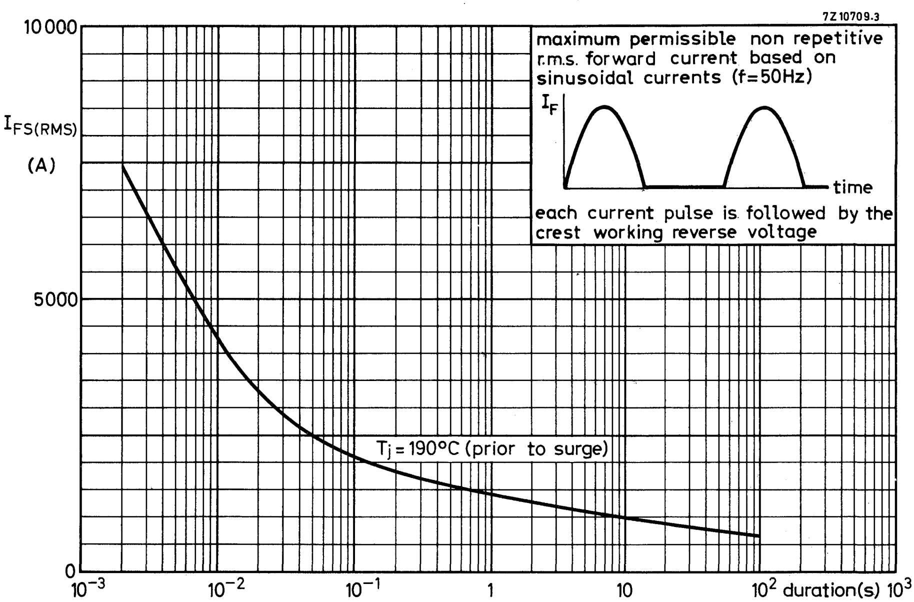
	BYX51-1200(R)	BYX51-1600(R) BYX51-2000(R)	
$n \geq$	$1.88\ V_{RWMtot} - 0.5$	$1.25\ V_{RWMtot} - 0.5$	
R	2.2	3.3	kΩ
P(R) (single phase rectifier)	75	115	W
P(R) (poly phase rectifier)	120	180	W

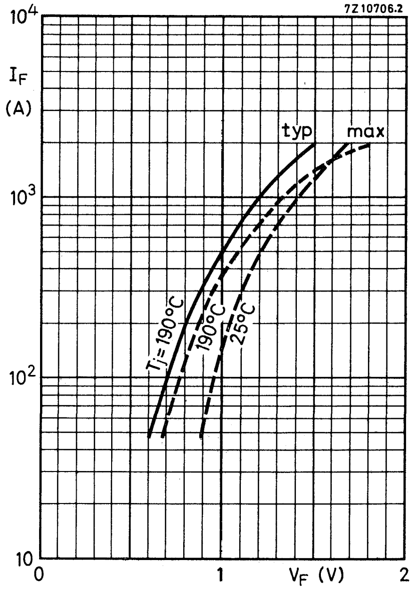


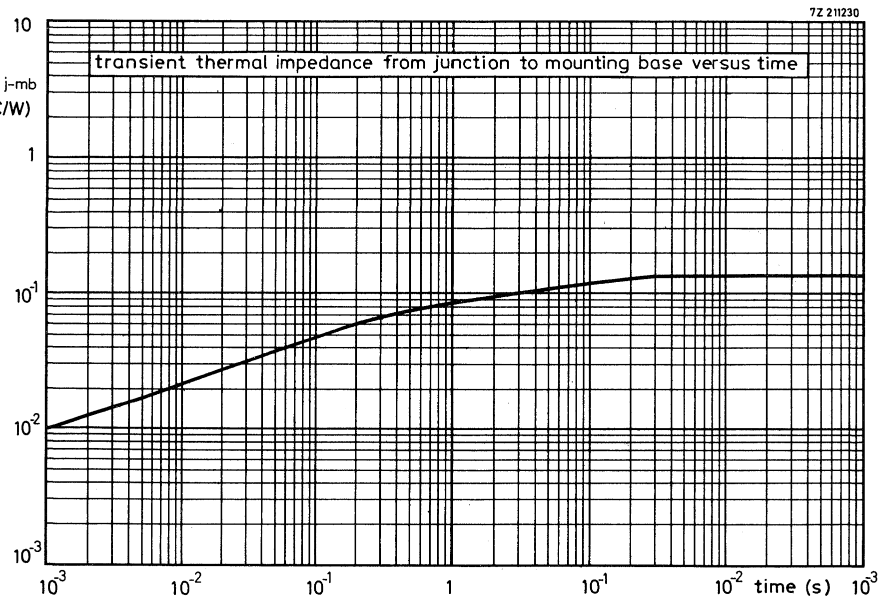
n = number of diodes in series
P(R) = power rating of R
V_{RWMtot} = crest working voltage across diode string, including maximum expected voltage fluctuation (in kV)



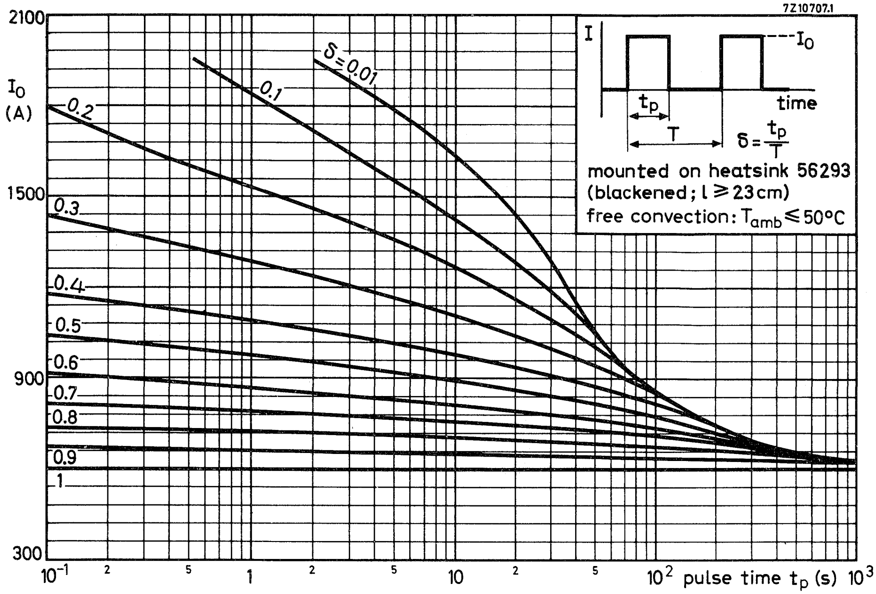
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 0.39$ °C/W

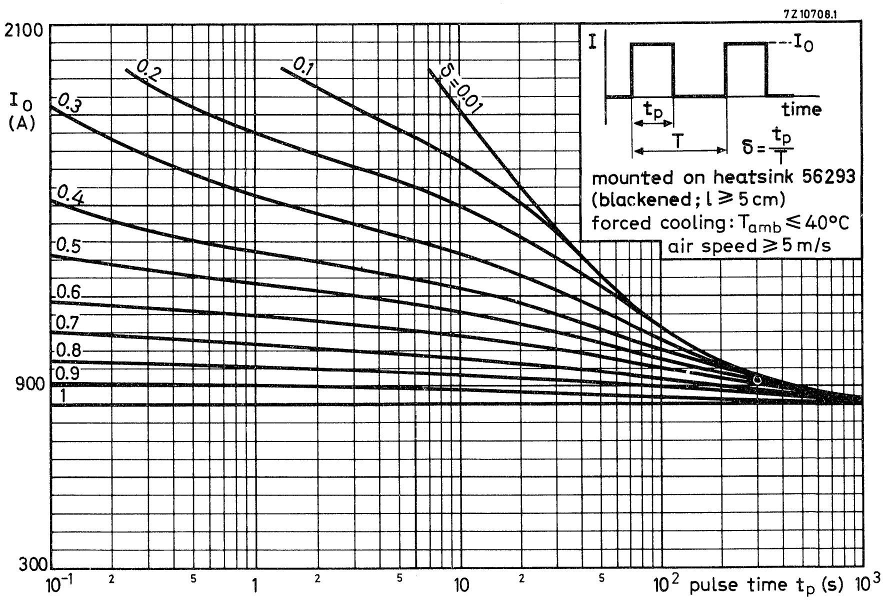



7Z10706.2
I_F
(A)
typ
max
$T_j = 190°C$
190°C
25°C
V_F (V)


7Z 211230
transient thermal impedance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$
(°C/W)
time (s)

MAXIMUM ALLOWABLE OUTPUT CURRENT OF A 3-PHASE BRIDGE RECTIFIER
UNDER INTERMITTENT LOAD





SILICON RECTIFIER DIODES

Silicon rectifier diodes in a DO-5 metal envelope intended for power rectifier applications. The series consists of the following types.
Normal polarity (cathode to stud): BYX52-300 to BYX52-1200
Reverse polarity (anode to stud) : BYX52-300R to BYX52-1200R.

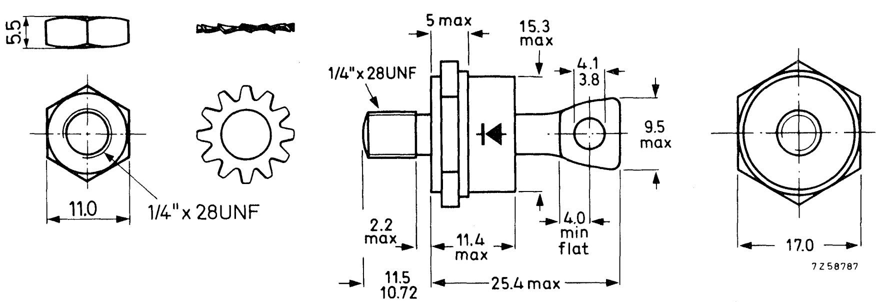
QUICK REFERENCE DATA

			BYX52-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V

Average forward current at T_{mb} = 125 °C	I_{FAV}	max.	40	A
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.	800	A
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.8	°C/W

MECHANICAL DATA Dimensions in mm

DO-5



Net weight: 20.5 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request:
56264A; 56309B; 56309R

Torque on nut: min. 17.5 kg cm
(1.75 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)

All information applies to frequencies from 50 Hz to 400 Hz

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

Voltages			BYX52-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Non repetitive peak reverse voltage ($t \leqslant 10$ ms)	V_{RSM}	max.	300	600	900	1200	V

Currents				
Average forward current (averaged over any 20 ms period) $T_{mb} = 125\ ^oC$	I_{FAV}	max.	40	A
R.M.S. forward current	$I_{F(RMS)}$	max.	75	A
Forward current (d.c.)	I_F	max.	75	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non repetitive peak forward current at $T_j = 175\ ^oC$ t = 10 ms; (see page 4)	I_{FSM}	max.	800	A
I squared t for fusing	I^2t	max.	3200	A^2s

Temperatures			
Storage temperature	T_{stg}	−55 to +175	^oC
Junction temperature	T_j	−55 to +175	^oC

THERMAL RESISTANCE

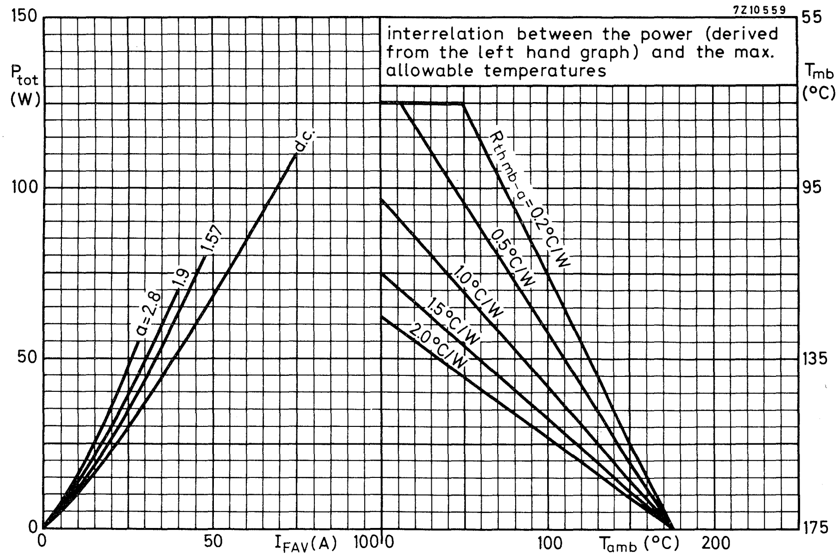
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.8	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^oC/W$

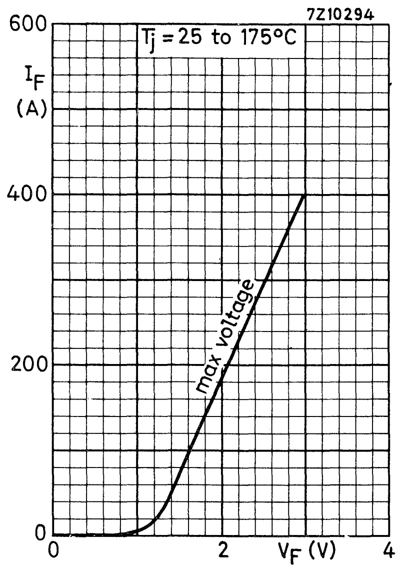
CHARACTERISTICS

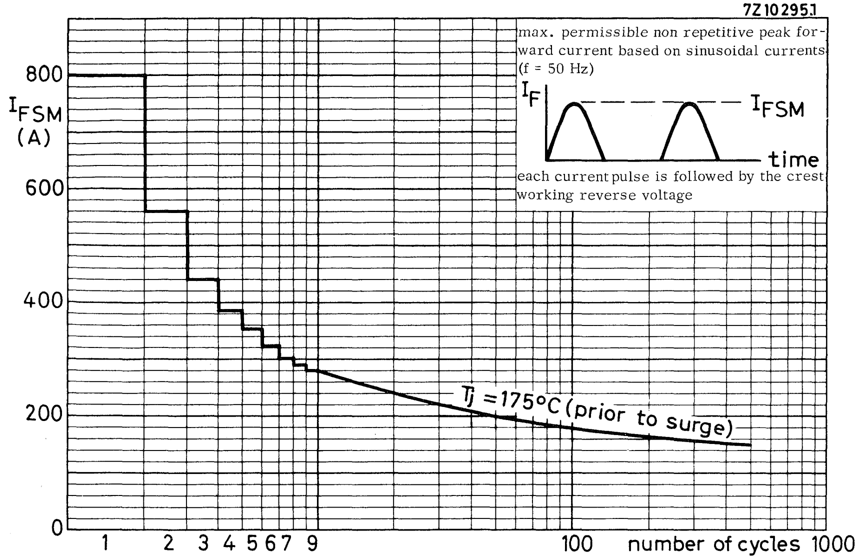
Forward voltage at $I_F = 150$ A; $T_j = 25\ ^oC$	V_F	<	1.8	V
Reverse current at $V_R = V_{RWMmax}$; $T_j = 125\ ^oC$	I_R	<	1.6	mA

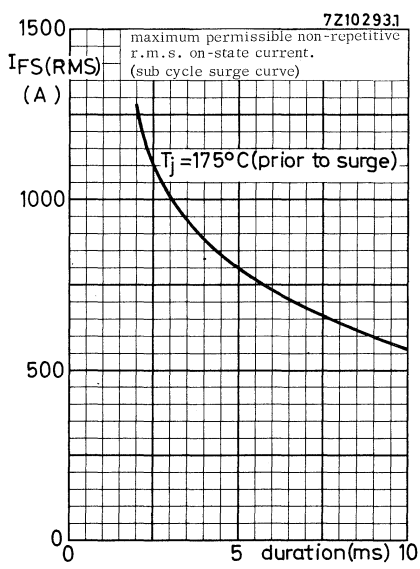
OPERATING NOTES (See also general pages at the beginning of this section)

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that 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.


7Z10559
150
100
50
0
P_{tot}
(W)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
55
95
135
175
T_{mb}
(°C)
d.c.
1.57
1.9
a=2.8
$R_{th\,mb-a}$=0.2°C/W
0.5°C/W
1.0°C/W
1.5°C/W
2.0°C/W
0
50
I_{FAV}(A)
100
0
100
T_{amb} (°C)
200


7Z10294
600
400
200
0
I_F
(A)
T_j = 25 to 175°C
max voltage
0
2
V_F (V)
4


7Z10295.1
max. permissible non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
each current pulse is followed by the crest working reverse voltage
I_F
I_{FSM}
time
I_{FSM} (A)
800
600
400
200
0
T_j = 175 °C (prior to surge)
1
2
3 4 5 6 7 9
100
number of cycles
1000


7Z10293.1
maximum permissible non-repetitive r.m.s. on-state current. (sub cycle surge curve)
$I_{FS(RMS)}$ (A)
1500
1000
500
0
T_j = 175 °C (prior to surge)
0
5
duration (ms)
10

CONTROLLED AVALANCHE RECTIFIER DIODES

Silicon diodes in a DO-5 metal envelope, capable of absorbing transients and intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX56-600; BYX56-800; BYX56-1000.
Reverse polarity (anode to stud): BYX56-600R; BYX56-800R; BYX56-1000R.

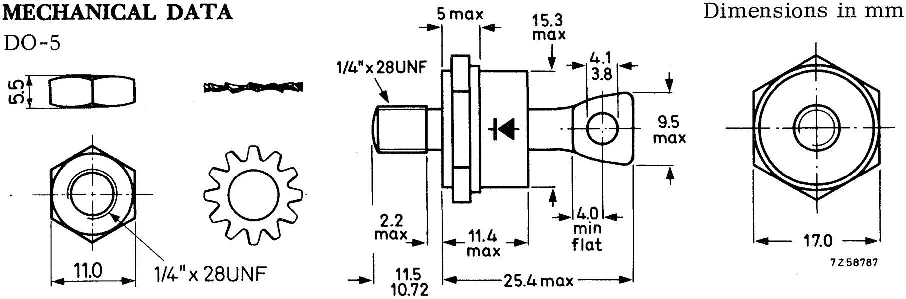
QUICK REFERENCE DATA

			BYX56-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	V
Average forward current						
up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	47 A			
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40 A			
Non-repetitive peak forward current						
t = 10 ms; T_j = 175 °C prior to surge	I_{FSM}	max.	800 A			
Non-repetitive peak reverse power dissipation (t = 10 μs; T_j = 25 °C)	P_{RSM}	max.	40 kW			
Junction temperature	T_j	max.	175 °C			

MECHANICAL DATA

DO-5

Dimensions in mm



Net weight: 20.5 g
Diameter of clearance hole: max. 6.5 mm
Accesories supplied on request:
56264A; 56309B; 56309R

Torque on nut: min. 17.5 kg cm
(1.75 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)
The mark shown applies to normal polarity types

All information applies to frequencies up to 400 Hz

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

Voltages			BYX56-600(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) up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	47	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
Forward current (d.c.)	I_F	max.	75	A
R.M.S. forward current	$I_{F(RMS)}$	max.	75	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 175 °C prior to surge	I_{FSM}	max.	800	A
I squared t for fusing (t ≤ 10 ms)	I^2t	max.	3200	A^2s

Reverse power dissipation

Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	6.5	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	40	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	6.5	kW

Temperatures

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

THERMAL RESISTANCE

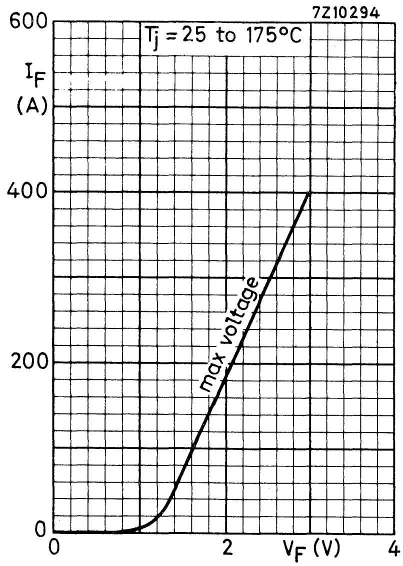
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.8	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}h}$	=	0.03	°C/W

CHARACTERISTICS

		BYX56-600(R)	800(R)	1000(R)	
Forward voltage at I_F = 150 A; T_j = 25 °C	V_F	< 1.8	1.8	1.8	V [1]
Reverse avalanche breakdown voltage					
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	> 750	1000	1250	V
		< 2000	2000	2000	V
Peak reverse current					
$V_{RM} = V_{RWMmax}$; T_j = 125 °C	I_{RM}	< 1.6	1.6	1.6	mA

OPERATING NOTES (see general pages at the beginning of this section)

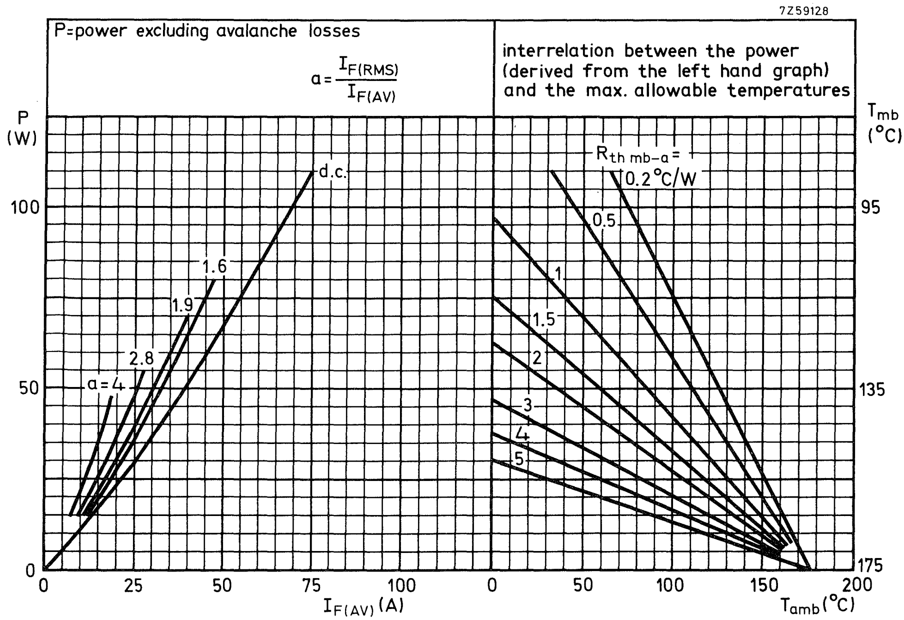
The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

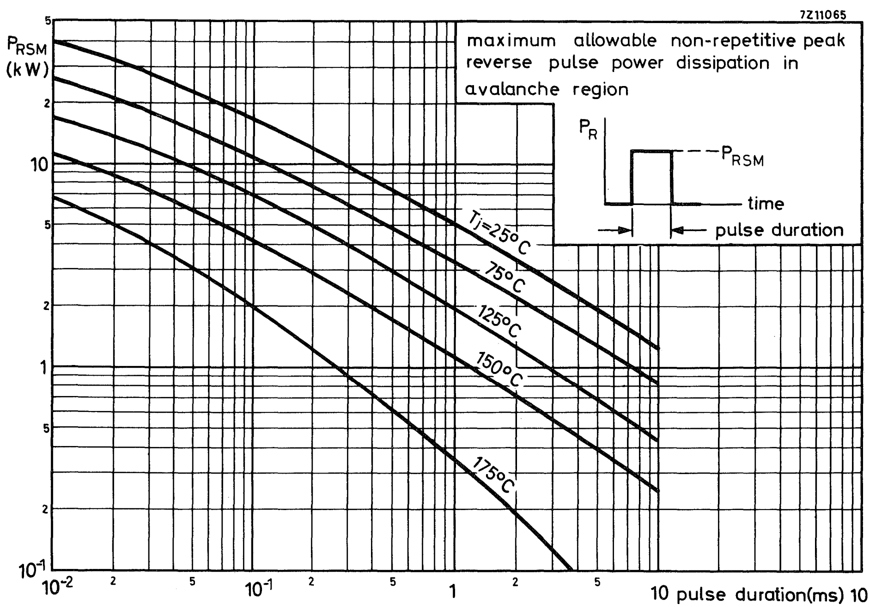


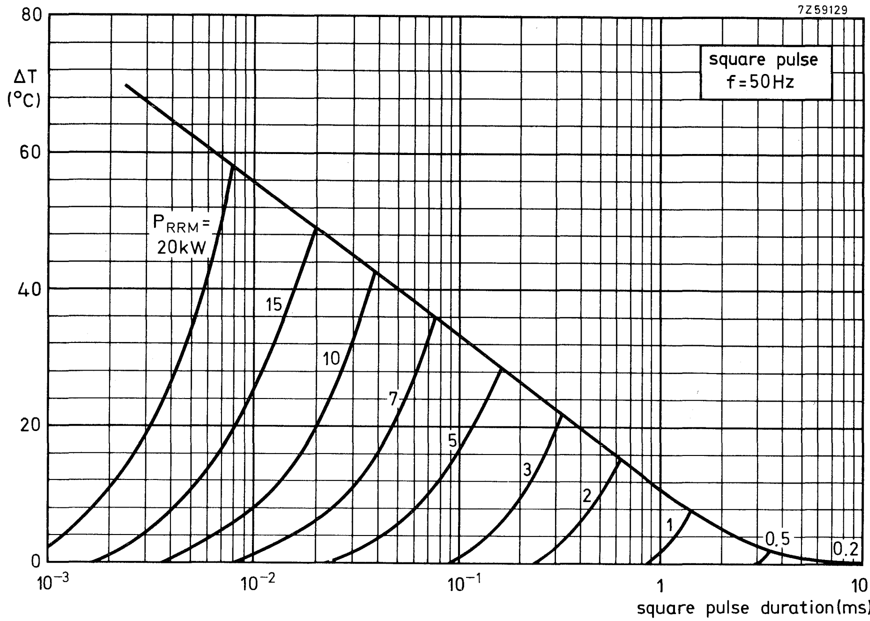
APPLICATION INFORMATION

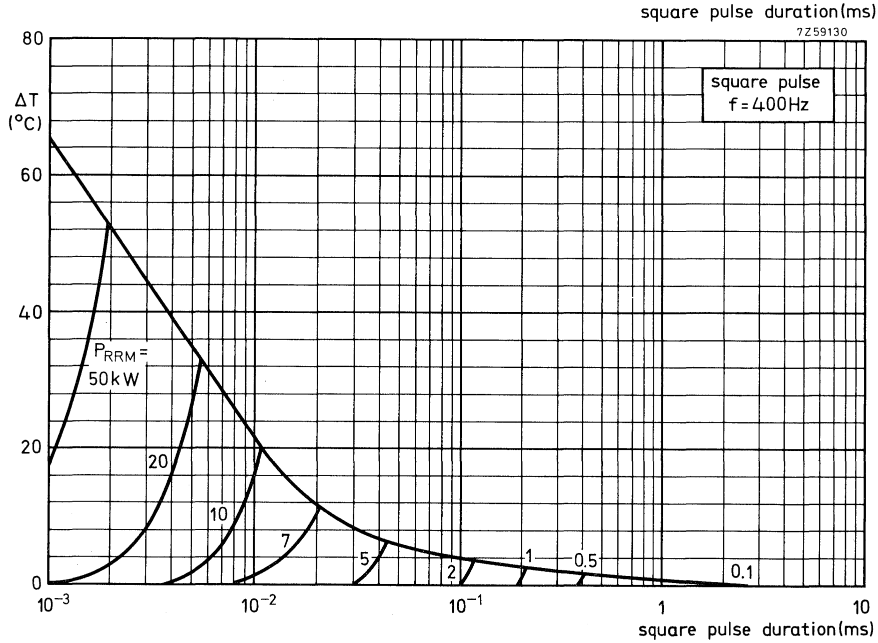
See general pages at the beginning of this section

[1] Measured under pulsed conditions to avoid excessive dissipation.

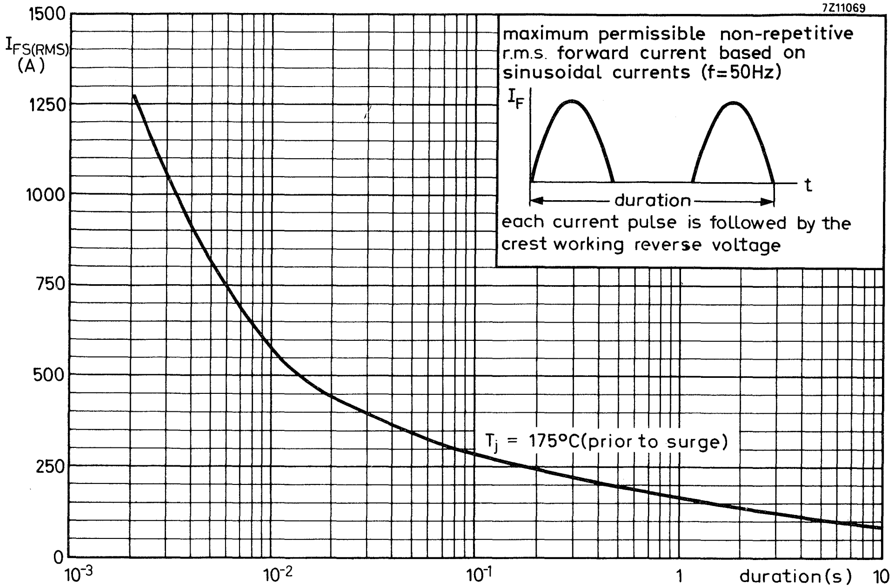

7Z59128
P=power excluding avalanche losses
$a = \frac{I_{F(RMS)}}{I_{F(AV)}}$
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
T_{mb} (°C)
d.c.
1.6
1.9
2.8
a=4
$R_{th\,mb-a}$ =
0.2 °C/W
0.5
1
1.5
2
3
4
5
100
50
0
95
135
175
0
25
50
75
100
0
50
100
150
200
$I_{F(AV)}$ (A)
T_{amb} (°C)

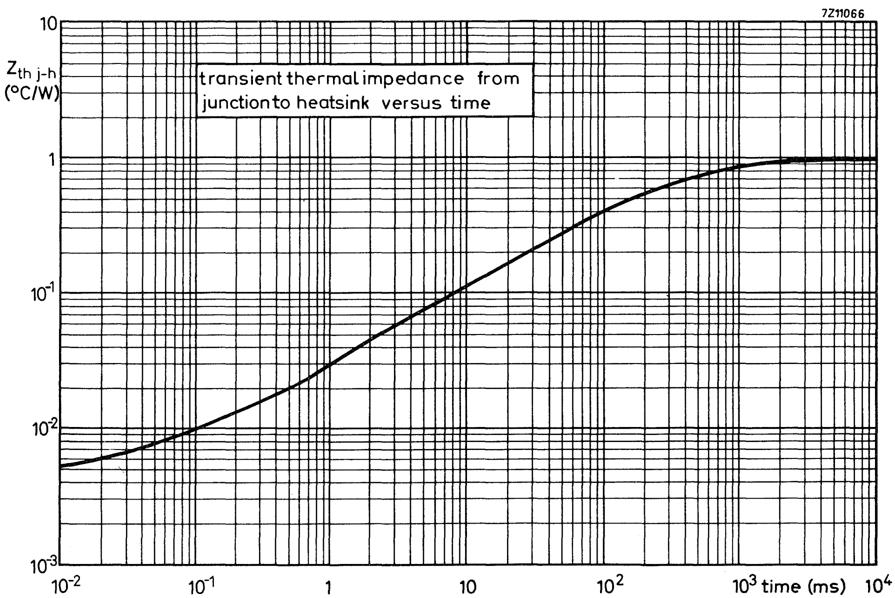

7Z11065
maximum allowable non-repetitive peak reverse pulse power dissipation in avalanche region
P_{RSM} (kW)
P_R
P_{RSM}
time
pulse duration
T_j=25°C
75°C
125°C
150°C
175°C
10
1
10^{-1}
10^{-2}
10^{-1}
1
10 pulse duration(ms) 10





ΔT = neccessary derating of $T_{j\,max}$ to accommodate repetitive transients in the reverse direction. Allowance can be made for this by assuming the ambient temperature ΔT higher.


7Z11069
1500
$I_{FS(RMS)}$
(A)
1250
1000
750
500
250
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive
r.m.s. forward current based on
sinusoidal currents (f=50Hz)
I_F
t
duration
each current pulse is followed by the
crest working reverse voltage
T_j = 175°C(prior to surge)


7Z11066
10
$Z_{th\ j\text{-}h}$
(°C/W)
1
10^{-1}
10^{-2}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3 time (ms)
10^4
transient thermal impedance from
junction to heatsink versus time

FAST RECOVERY RECTIFIER DIODES

Diffused silicon diodes in a metal envelope, primarily intended for use in high frequency power supplies, inverters, choppers, sonar power supplies and ultra-sonic systems.
The series consists of the normal polarity types (cathode to stud) BYX59-200 to -500.

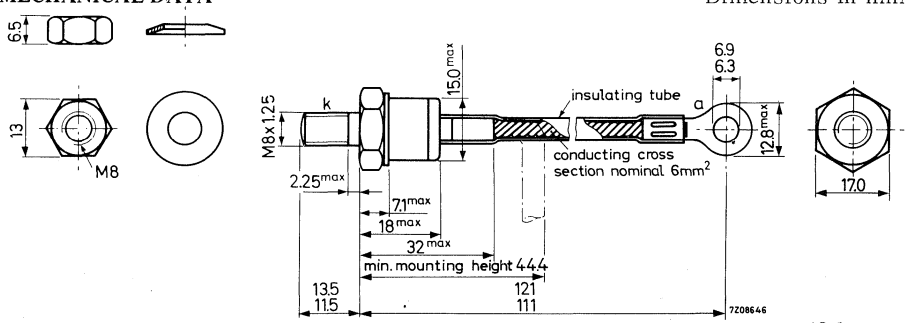
QUICK REFERENCE DATA

			BYX59 – 200	300	400	500	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	500	V

Average forward current up to T_{mb} = 105 °C	$I_{F(AV)}$	max.	70	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
Non-repetitive peak forward current t = 10 ms; T_j = 150 °C prior to surge	I_{FSM}	max.	1200	A
Junction temperature	T_j	max.	150	°C
Reverse recovery charge when switched from I_F = 50 A to $V_R \geq 30$ V with $-\frac{dI}{dt}$ = 50 A/µs; T_j = 25 °C	Q_s	<	7.5	µC

MECHANICAL DATA

Dimensions in mm



Net weight: 42 g
Diameter of clearance hole: max. 8.5 mm

Torque on nut: min 40 kg cm
(4 Newton-metres)
max. 60 kg cm
(6 Newton-metres)

All information applies to frequencies up to 50 kHz

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

Voltages [1]

			BYX59 – 200	300	400	500	
Continuous reverse voltage	V_R	max.	200	300	400	500	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	500	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	220	330	440	550	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 105 °C	$I_{F(AV)}$	max.	70	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
Forward current (d. c.)	I_F	max.	120	A
R. M. S. forward current	$I_{F(RMS)}$	max.	120	A
Repetitive peak forward current	I_{FRM}	max.	1000	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) T_j = 150 °C prior to surge	I_{FSM}	max.	1200	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	7200	A^2s
Rate of change of commutation current	$-\frac{dI}{dt}$	max.	100	A/µs

Temperatures

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

THERMAL

From junction to mounting base	$R_{th\ j-mb}$	=	0.4	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb-h}$	=	0.4	°C/W
with heatsink compound (e. g. Dow Corning 340)	$R_{th\ mb-h}$	=	0.2	°C/W
Transient thermal impedance; $t = 1$ ms	$Z_{th\ j-mb}$	=	0.045	°C/W

[1]) To ensure thermal stability $R_{th\ j-a} \leq 0.75$ °C/W (continuous reverse voltage) or ≤ 1.5 °C/W (a. c.)
For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see page 4.
For continuous reverse voltage: $R_{th\ j-a} = 1$ °C/W, then $T_{j\ max} = 145$ °C
$R_{th\ j-a} = 1.2$ °C/W, then $T_{j\ max} = 140$ °C

CHARACTERISTICS

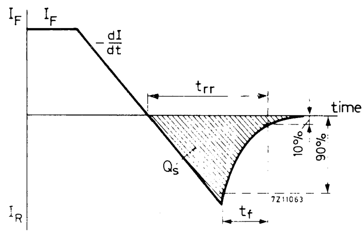
			BYX59 – 200	300	400	500	
Forward voltage $I_F = 250$ A; $T_j = 25$ °C	V_F	<	1.8	1.8	1.8	1.8	V[1]
Peak reverse current $V_{RM} = V_{RWM\,max}$; $T_j = 125$ °C	I_{RM}	<	25	25	18	15	mA

Reverse recovery when switched from

$I_F = 50$ A to $V_R \geq 30$ V

with $-\frac{dI}{dt} = 50$ A/μs; $T_j = 25$ °C

reverse recovery charge	Q_s	<	7.5	μC
reverse recovery time	t_{rr}	<	0.7	μs
fall time	t_f	<	0.3	μs



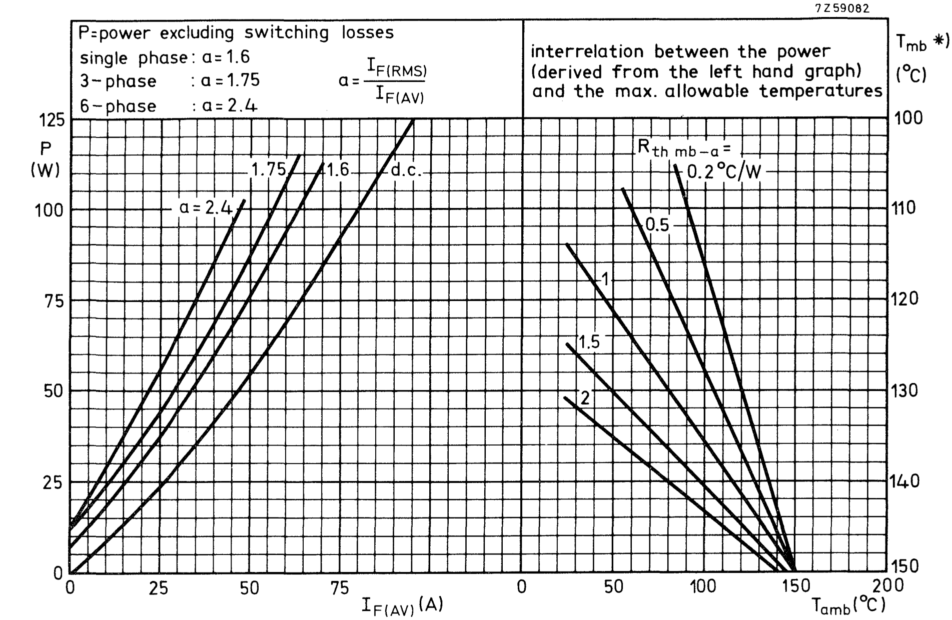
OPERATING NOTES See also general pages at the beginning of this section.

1. Square wave operation
   When I_F has been flowing sufficiently long for steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during t_f as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graph on page 4.
2. Sine wave operation
   Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of -dI/dt), so that power loss due to reverse recovery may be safely ignored for frequencies up to 20 kHz.

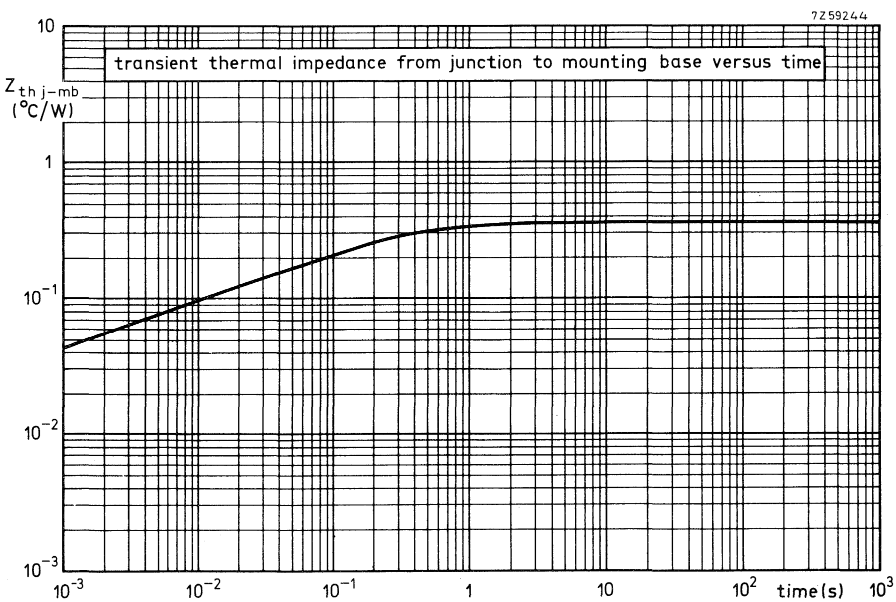
APPLICATION INFORMATION

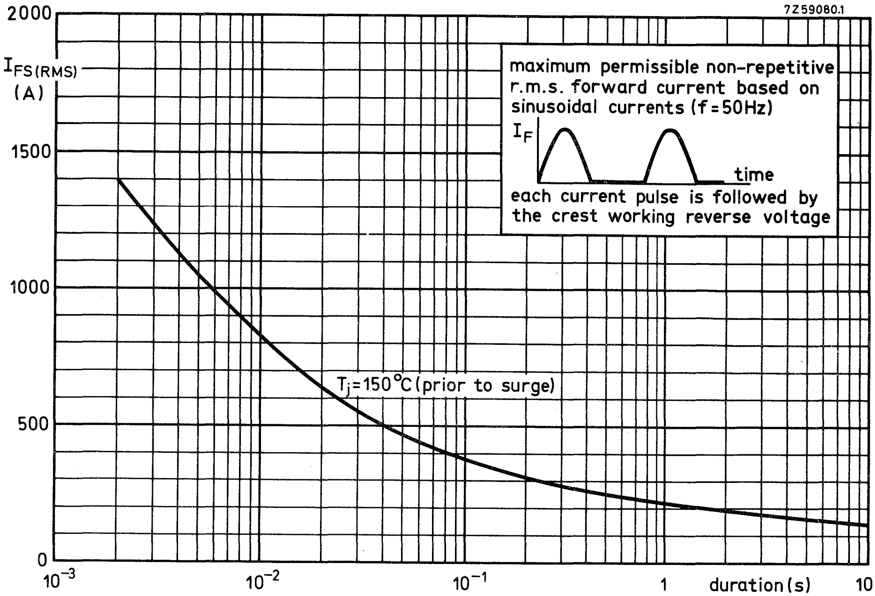
See general pages at the beginning of this section.

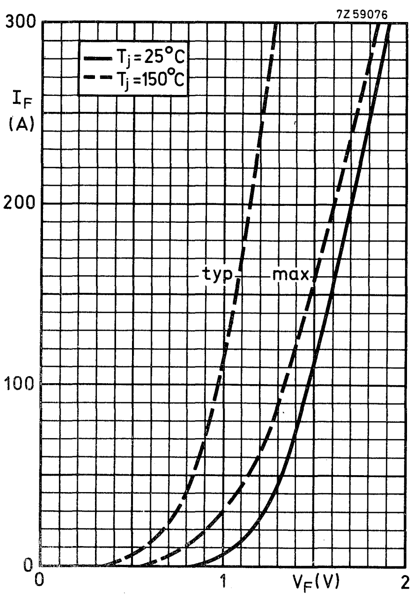
[1]) Measured under pulsed conditions to avoid excessive dissipation.

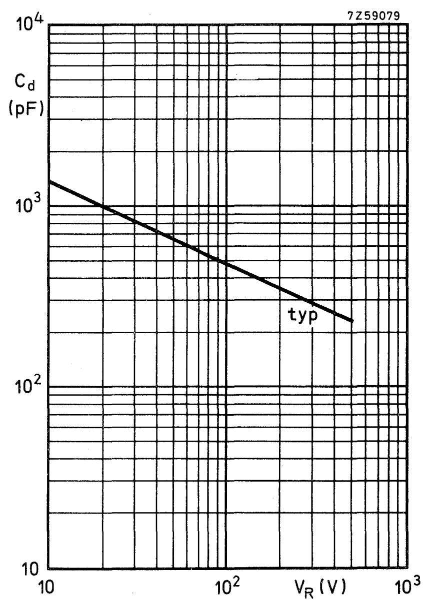


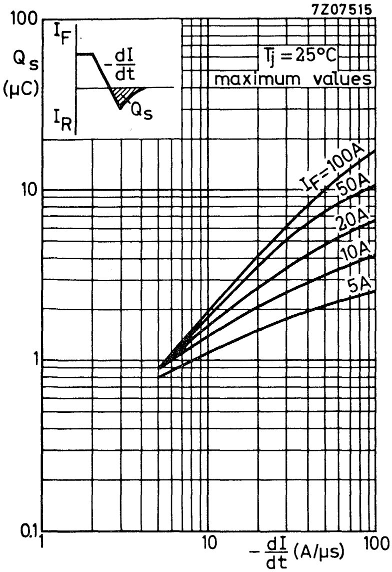
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.1\ ^{\circ}C/W$

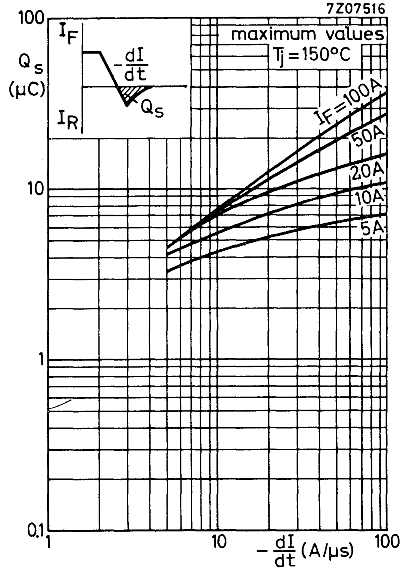


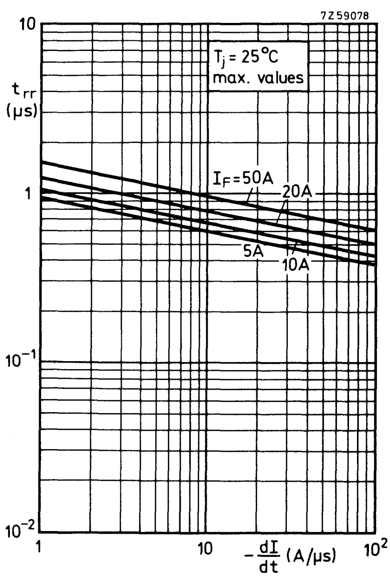

7Z59080.1
2000
$I_{FS(RMS)}$
(A)
1500
1000
500
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 150 °C (prior to surge)

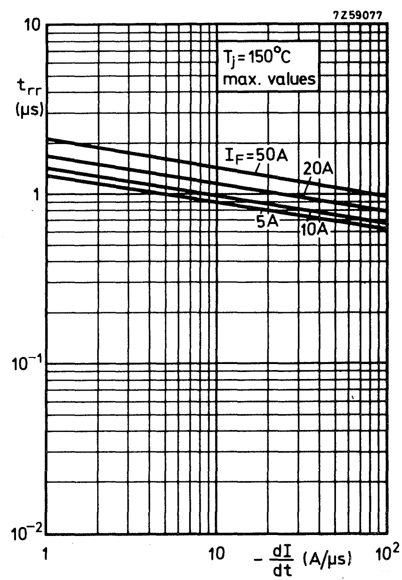

7Z59076
300
I_F
(A)
200
100
0
0
1
V_F (V)
2
T_j = 25 °C
T_j = 150 °C
typ
max


7Z59079
10^4
C_d
(pF)
10^3
10^2
10
10
10^2
V_R (V)
10^3
typ

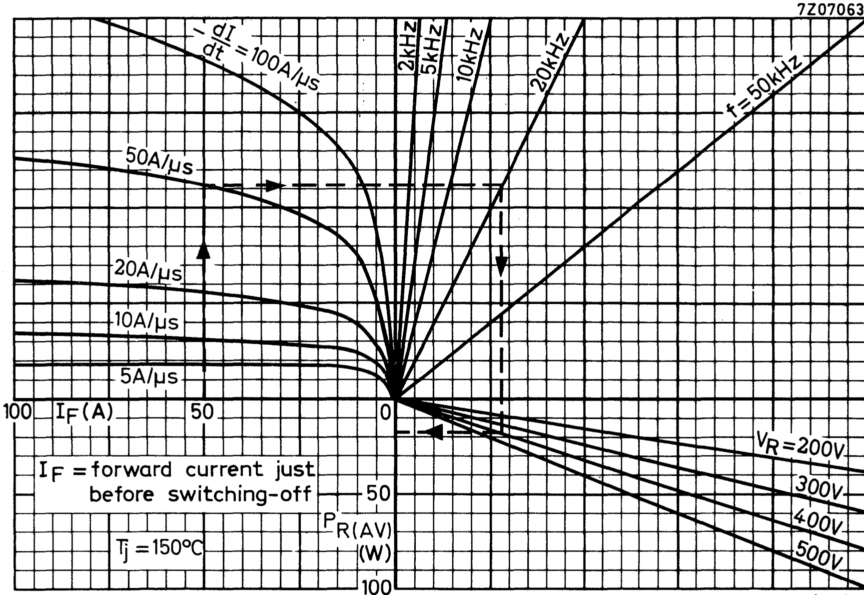

7Z07515
100
10
1
0.1
1
10
100
Q_s (μC)
I_F
I_R
$-\frac{dI}{dt}$
Q_s
$T_j = 25°C$
maximum values
I_F=100A
50A
20A
10A
5A
$-\frac{dI}{dt}$ (A/μs)


7Z07516
100
10
1
0.1
1
10
100
Q_s (μC)
I_F
I_R
$-\frac{dI}{dt}$
Q_s
maximum values
$T_j = 150°C$
I_F=100A
50A
20A
10A
5A
$-\frac{dI}{dt}$ (A/μs)


7Z59078
10
1
10^{-1}
10^{-2}
1
10
10^2
t_{rr} (μs)
$T_j = 25°C$
max. values
I_F=50A
20A
5A
10A
$-\frac{dI}{dt}$ (A/μs)


7Z59077
10
1
10^{-1}
10^{-2}
1
10
10^2
t_{rr} (μs)
$T_j = 150°C$
max. values
I_F=50A
20A
5A
10A
$-\frac{dI}{dt}$ (A/μs)

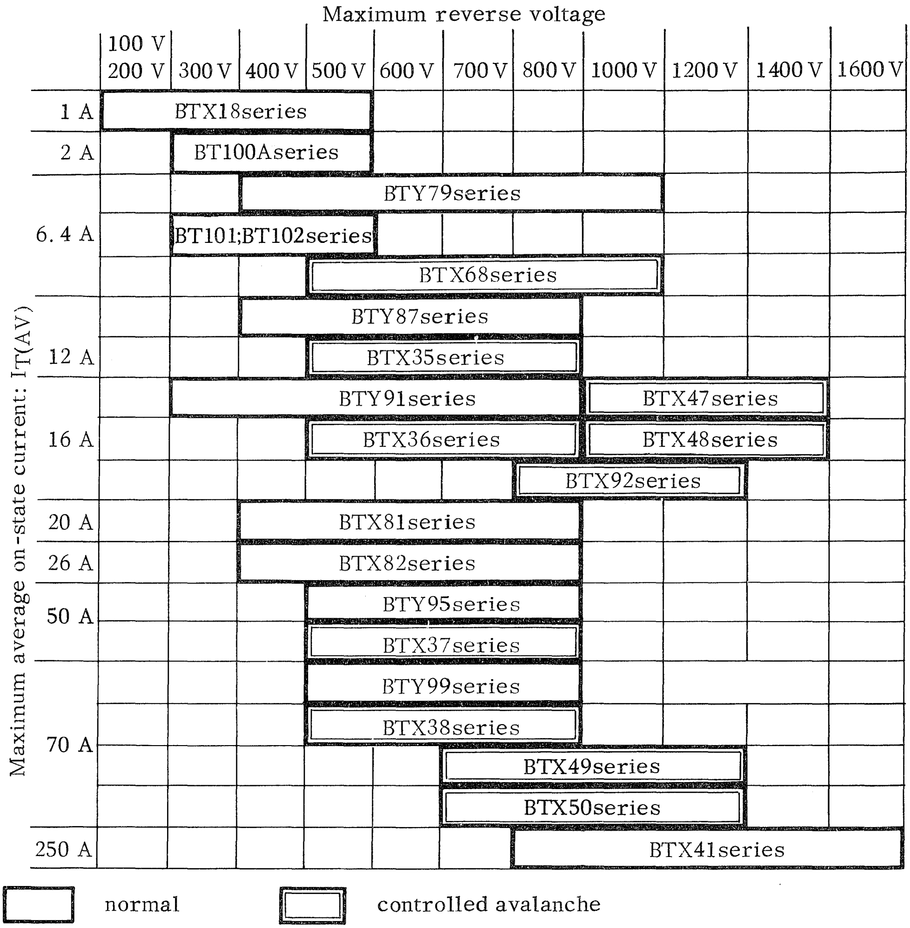
7Z07063.1



Nomogram: Power loss $P_{R(AV)}$ due to switching only (square wave operation)

Thyristors, diacs, triacs

TYPE SELECTION CHART



<u>Diac</u>
BR 100 : $V_{(BO)}$ 28 to 30 V; I_{FRM} max. 2 A

<u>Triac</u>
BTX94-400 to 1200: $I_{T(RMS)}$ max. 25 A

<u>Silicon Controlled Switch</u>
BRY39 : 70 V; 100 mA

OPERATING NOTES

When there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage [1], a damping circuit should be connected across the transformer.
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_{RSM} = the transient voltage peak produced by the transformer
V_{RWM} = the actually applied crest working reverse voltage

The capacitance values calculated from the above table are minimum values; to allow for circuit variations and component tolerances, larger values should be used.

[1]) For controlled avalanche types read: non-repetitive peak reverse power.

SILICON BI-DIRECTIONAL TRIGGER DEVICE

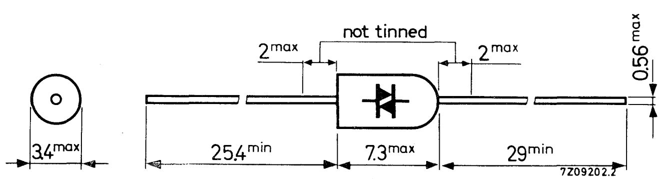
Silicon bi-directional trigger device in a DO-14 plastic envelope intended for use in triac and thyristor trigger circuits.

QUICK REFERENCE DATA				
Breakover voltage	$V_{(BO)}$		28 to 36	V
Breakback voltage at I_F = 10 mA	ΔV	>	6	V
Repetitive peak current ($t \leq 20\ \mu s$)	I_{FRM}	max.	2	A

MECHANICAL DATA

Dimensions in mm

DO-14



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

RATINGS (Limiting values) [1]

Total power dissipation	P_{tot}	max.	150	mW
Repetitive peak current ($t \leq 20\ \mu s$)	I_{FRM}	max.	2	A
Storage temperature	T_{stg}		-65 to +100	^oC
Junction temperature	T_j	max.	100	^oC

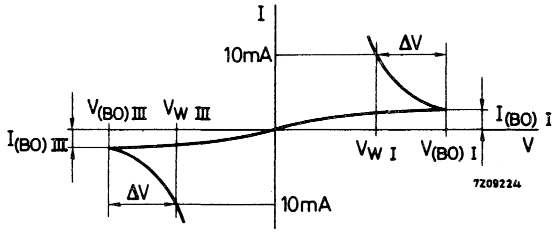
THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.2	$^oC/mW$

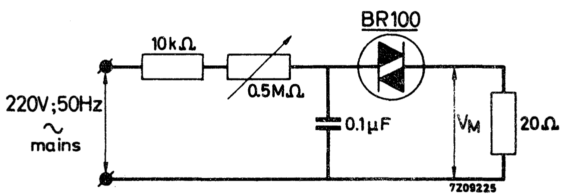
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Breakover voltage at $\frac{dV}{dt}$ = 10 V/ms	$V_{(BO)}$	28 to 36	V
Breakover voltage symmetry	$\lvert V_{(BO)I} - V_{(BO)III} \rvert$	< 3	V
Breakback voltage I_F = 10 mA; $\frac{dV}{dt}$ = 10 V/ms	$\Delta V = V_{(BO)} - V_W$	> 6	V
Breakover current	$I_{(BO)}$	< 100	μA



Test circuit for peak output voltage



V_M measured across a resistor of 20 Ω (instead of a thyristor) will be > 5 V.

SILICON CONTROLLED SWITCH

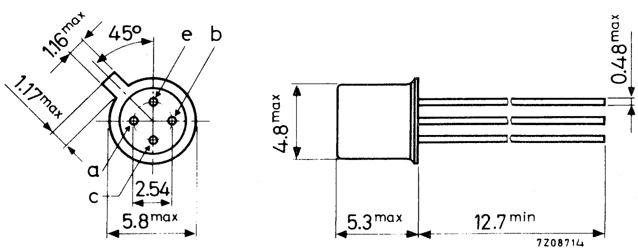
The BRY39 is a planar p-n-p-n switch in a TO-72 metal envelope, intended as driver for numerical indicator tubes and other switching applications.
It is an integrated pnp-npn transistor pair of which all electrodes are accessible.
The collector of the n-p-n transistor is connected to the case.

QUICK REFERENCE DATA

P–N–P transistor				
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	70	V
N–P–N transistor				
Collector-base voltage (open emitter)	V_{CBO}	max.	70	V
Emitter current (peak value)	$-I_{EM}$	max.	500	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	°C
Forward on-state voltage				
I_A = 50 mA; I_C = 0; R_{BE} = 10 kΩ	V_{AE}	<	1.4	V
Holding current				
I_C = 10 mA; $-V_{BB}$ = 2 V; R_{BE} = 10 kΩ	I_H	<	1.0	mA
Turn on time	t_{on}	<	0.25	μs
Turn off time	t_q	<	5.0	μs

MECHANICAL DATA Dimensions in mm

Collector connected to case
TO-72



Accessories available: 56246; 56263.

RATINGS (Limiting values) [1]

Voltages			p-n-p	n-p-n	
Collector-base voltage (open emitter)	V_{CBO}	max.	−70	70 [2]	V
Collector-emitter voltage (R_{BE} = 10 kΩ)	V_{CER}	max.		70 [2]	V
Collector-emitter voltage (open base)	V_{CEO}	max.	−70		V
Emitter-base voltage (open collector)	V_{EBO}	max.	−70 [2]	5 [3]	V

Currents			p-n-p	n-p-n	
Emitter current (d.c.)	I_E	max.	100	−100	mA
Emitter current (peak value) $t_p \leq 1$ ms; $\delta \leq 0.05$	I_{EM}	max.	500	−500	mA
Collector current (d.c.)	I_C	max.		50	mA
Collector current (peak value)	I_{CM}	max.		100 [4]	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW

Temperatures

Storage temperature	T_{stg}		−65 to + 200	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0.5	°C/mW

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

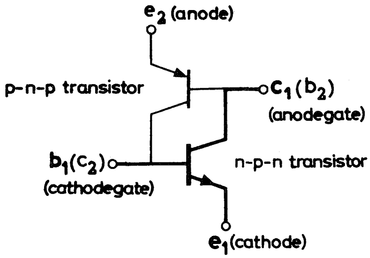
[2] In numerical indicator tube driver circuits higher voltages are allowed, provided the collector current does not exceed a d.c. current of 1 mA.

[3] In numerical indicator tube driver circuits higher voltages are allowed during the discharge of a capacitor of max. 390 pF, provided the charge does not exceed 50 nC and the current is limited to 150 mA.

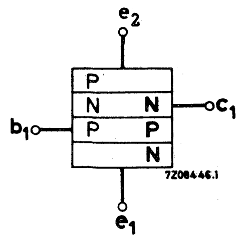
[4] During switching-on, the device can withstand a discharge of a capacitor of max. 500 pF. This capacitor is charged, when the transistor is in cut-off condition, with a collector supply voltage of 160 V with a series resistance of 100 kΩ.

MEANING OF SYMBOLS, used in the schematic presentation of the S.C.S.

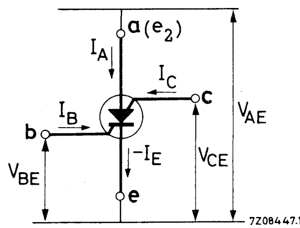
2 transistors equivalent circuit
n-p-n transistor + p-n-p transistor



p-n-p-n S.C.S. equivalent circuit



S.C.S. symbol



a = anode (emitter of p-n-p transistor)

CHARACTERISTICS T_j = 25 °C unless otherwise specified

INDIVIDUAL N-P-N TRANSISTOR

Collector cut-off current

V_{CE} = 70 V; R_{BE} = 10 kΩ	I_{CER}	<	100 nA
V_{CE} = 70 V; R_{BE} = 10 kΩ; T_j = 150 °C	I_{CER}	<	10 μA

Emitter cut-off current

I_C = 0; V_{EB} = 5 V; T_j = 150 °C	I_{EBO}	<	10 μA

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

INDIVIDUAL N-P-N TRANSISTOR

Saturation voltages			
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	500 mV
	V_{BEsat}	<	900 mV
D.C. current gain			
I_C = 10 mA; V_{CE} = 2 V	h_{FE}	>	50
Transition frequency			
I_C = 10 mA; V_{CE} = 2 V	f_T	typ.	300 MHz
Collector capacitance			
$I_E = I_e$ = 0; V_{CB} = 20 V	C_c	<	5 pF
Emitter capacitance			
$I_C = I_c$ = 0; V_{EB} = 1 V	C_e	<	25 pF

INDIVIDUAL P-N-P TRANSISTOR

Collector cut-off current			
I_B = 0; $-V_{CE}$ = 70 V; T_j = 150 °C	$-I_{CEO}$	<	10 μA
Emitter cut-off current			
I_C = 0; $-V_{EB}$ = 70 V; T_j = 150 °C	$-I_{EBO}$	<	10 μA
D.C. current gain			
I_E = 1 mA; V_{CB} = 0	h_{FE}	0.25 to 2.5	

COMBINED DEVICE

Forward voltage at R_{BE} = 10 kΩ			
I_A = 50 mA; I_C = 0	V_{AE}	<	1.4 V
I_A = 50 mA; I_C = 0; T_j = −55 °C	V_{AE}	<	1.9 V
I_A = 1 mA; I_C = 10 mA	V_{AE}	<	1.2 V
Holding current at R_{BE} = 10 kΩ			
I_C = 10 mA; $-V_{BB}$ = 2 V	I_H	0.1 to 1.0 mA	

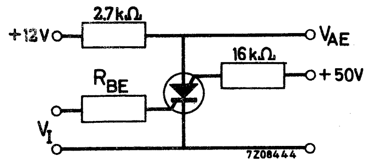
CHARACTERISTICS (continued) Tj = 25 °C unless otherwise specified

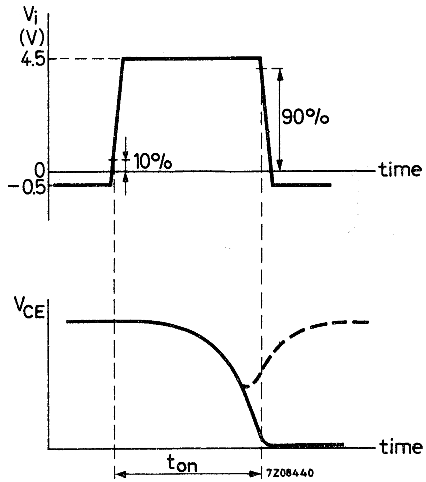
SWITCHING TIMES see also page 6

Turn on time when switched from

$-V_{BE}$ = 0.5 V to + V_{BE} = 4.5 V; R_{BE} = 1 kΩ t_{on} < 0.25 μs

R_{BE} = 10 kΩ t_{on} < 1.5 μs

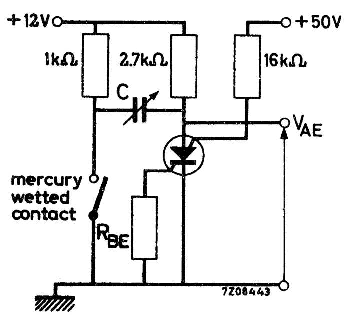


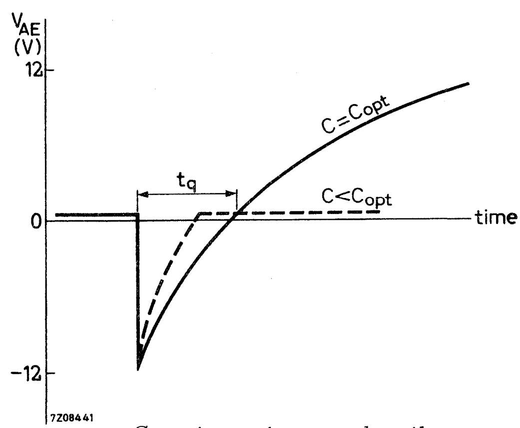


Pulse duration increased until dashed curve disappears

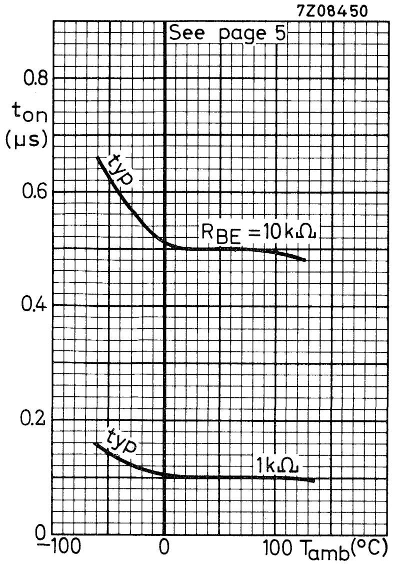
Turn off time

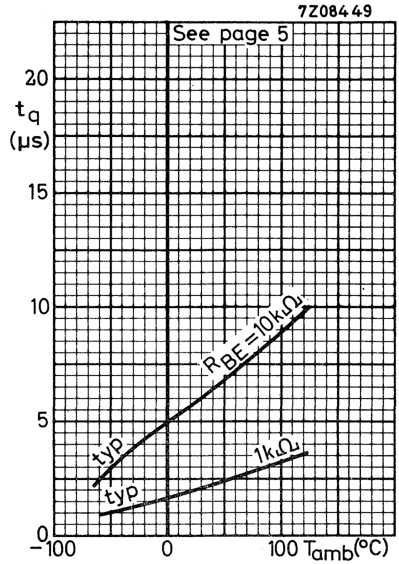
	R_{BE} = 1 kΩ	t_q < 5 μs
	R_{BE} = 10 kΩ	t_q < 8 μs
T_j = 125 °C;	R_{BE} = 10 kΩ	t_q < 15 μs

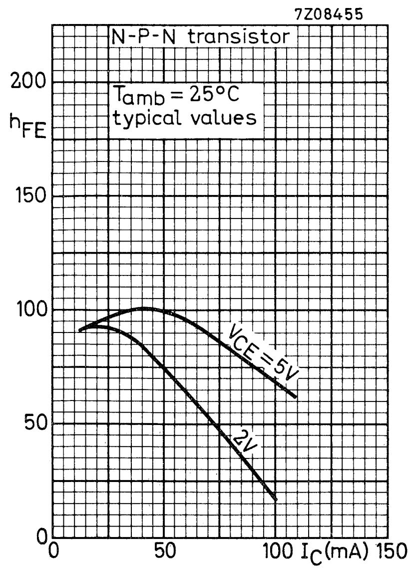


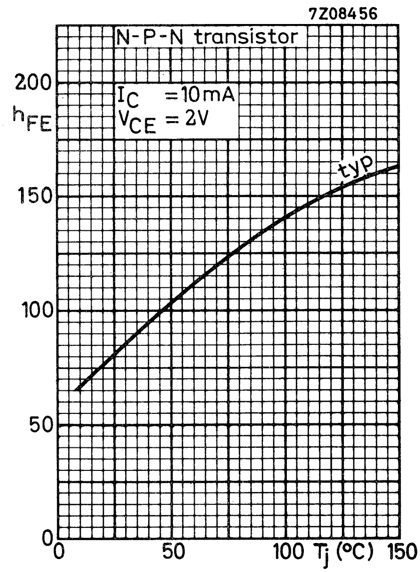


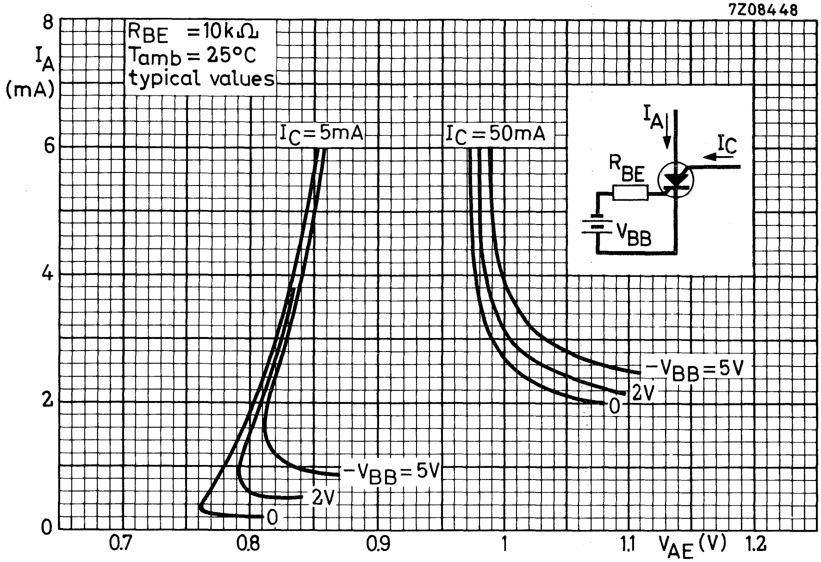
Capacitance increased until dashed curve disappears at C = Copt

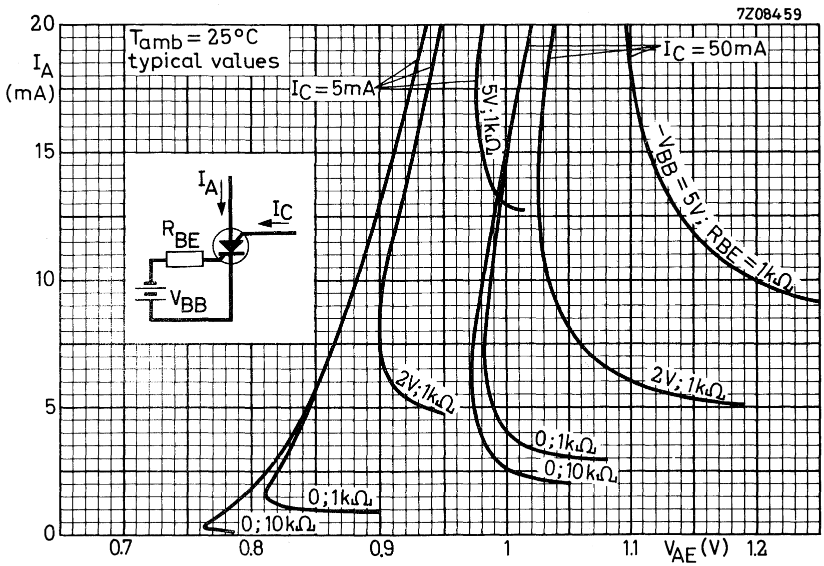

7Z08450
See page 5
0.8
t_{on} (μs)
0.6
0.4
0.2
0
typ
R_{BE} = 10 kΩ
typ
1 kΩ
−100
0
100 T_{amb} (°C)

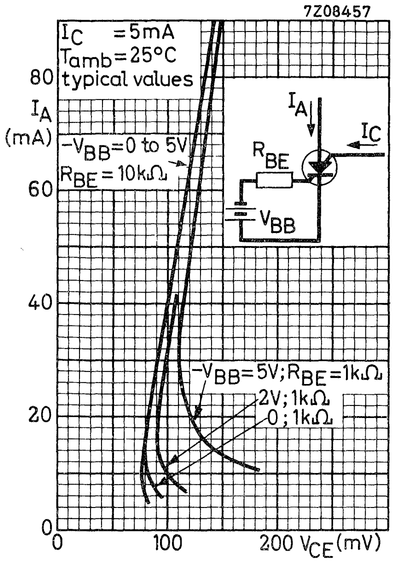

7Z08449
See page 5
20
t_q (μs)
15
10
5
0
R_{BE} = 10 kΩ
typ
typ
1 kΩ
−100
0
100 T_{amb} (°C)

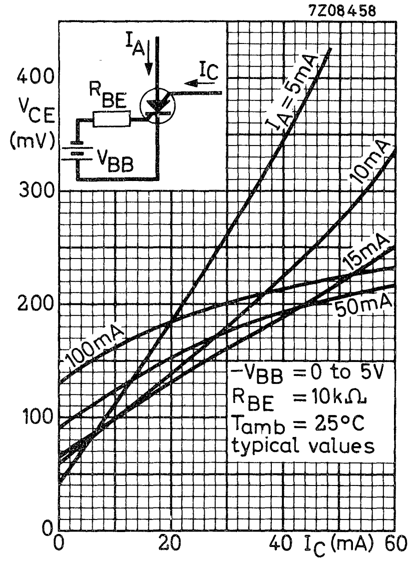

7Z08455
N-P-N transistor
T_{amb} = 25 °C
typical values
200
h_{FE}
150
100
50
0
V_{CE} = 5V
2V
0
50
100 I_C (mA) 150

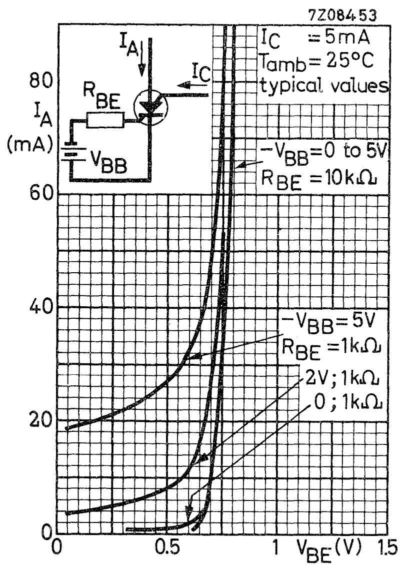

7Z08456
N-P-N transistor
I_C = 10 mA
V_{CE} = 2V
200
h_{FE}
150
100
50
0
typ
0
50
100 T_j (°C) 150

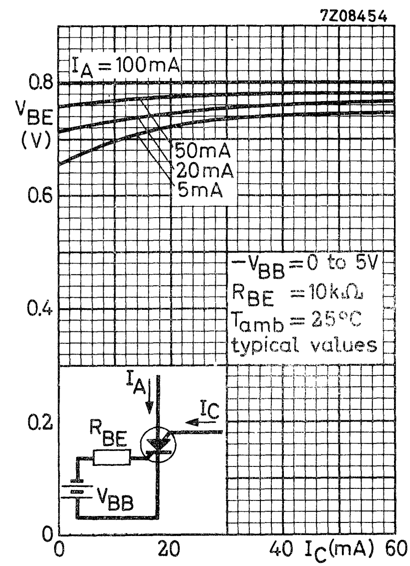

7Z08448
R_{BE} = 10kΩ
T_{amb} = 25°C
typical values
I_A (mA)
I_C = 5mA
I_C = 50mA
$-V_{BB}$ = 5V
2V
0
R_{BE}
V_{BB}
I_A
I_C
V_{AE} (V)
0.7
0.8
0.9
1
1.1
1.2

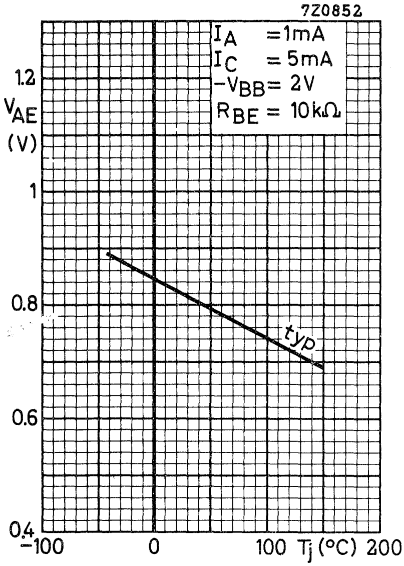

7Z08459
T_{amb} = 25°C
typical values
I_A (mA)
I_C = 5mA
I_C = 50mA
5V; 1kΩ
$-V_{BB}$ = 5V; R_{BE} = 1kΩ
2V; 1kΩ
0; 1kΩ
0; 10kΩ
R_{BE}
V_{BB}
I_A
I_C
V_{AE} (V)
0.7
0.8
0.9
1
1.1
1.2

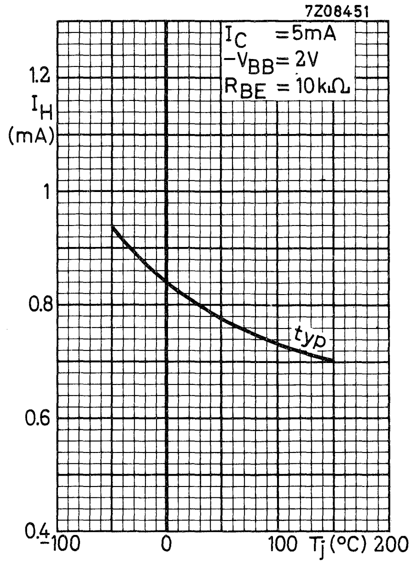

7Z08457
I_C = 5 mA
T_{amb} = 25 °C
typical values
I_A (mA)
$-V_{BB}$ = 0 to 5V
R_{BE} = 10 kΩ
I_A
I_C
R_{BE}
V_{BB}
$-V_{BB}$ = 5V; R_{BE} = 1 kΩ
2V; 1 kΩ
0; 1 kΩ
0
20
40
60
80
0
100
200
V_{CE} (mV)


7Z08458
I_A
I_C
R_{BE}
V_{BB}
V_{CE} (mV)
I_A = 5 mA
10 mA
15 mA
50 mA
100 mA
$-V_{BB}$ = 0 to 5V
R_{BE} = 10 kΩ
T_{amb} = 25 °C
typical values
0
100
200
300
400
0
20
40
60
I_C (mA)


7Z08453
I_A
I_C
R_{BE}
V_{BB}
I_C = 5 mA
T_{amb} = 25 °C
typical values
I_A (mA)
$-V_{BB}$ = 0 to 5V
R_{BE} = 10 kΩ
$-V_{BB}$ = 5V
R_{BE} = 1 kΩ
2V; 1 kΩ
0; 1 kΩ
0
20
40
60
80
0
0.5
1
1.5
V_{BE} (V)


7Z08454
I_A = 100 mA
V_{BE} (V)
50 mA
20 mA
5 mA
$-V_{BB}$ = 0 to 5V
R_{BE} = 10 kΩ
T_{amb} = 25 °C
typical values
I_A
I_C
R_{BE}
V_{BB}
0
0.2
0.4
0.6
0.8
0
20
40
60
I_C (mA)

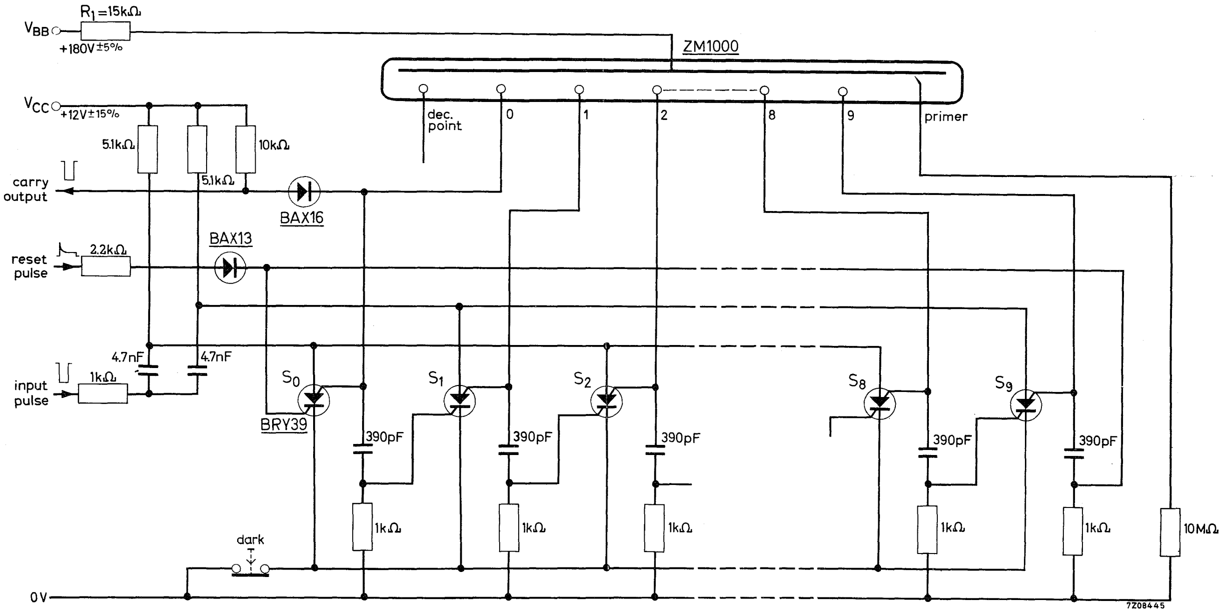

7Z0852
I_A = 1 mA
I_C = 5 mA
$-V_{BB}$ = 2 V
R_{BE} = 10 kΩ
V_{AE} (V)
1.2
1
0.8
0.6
0.4
typ
−100
0
100
200
T_j (°C)


7Z08451
I_C = 5 mA
$-V_{BB}$ = 2 V
R_{BE} = 10 kΩ
I_H (mA)
1.2
1
0.8
0.6
0.4
typ
−100
0
100
200
T_j (°C)

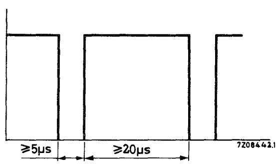
APPLICATION INFORMATION

Decade ring-counter circuit with display ($f \leq 40$ kHz)

Operating ambient temperature T_{amb} 0 to 70 ^{o}C



Input pulse:



All resistors 1/8 W; $\pm$ 5%; except R_1: $\pm$ 3%

SILICON THYRISTORS

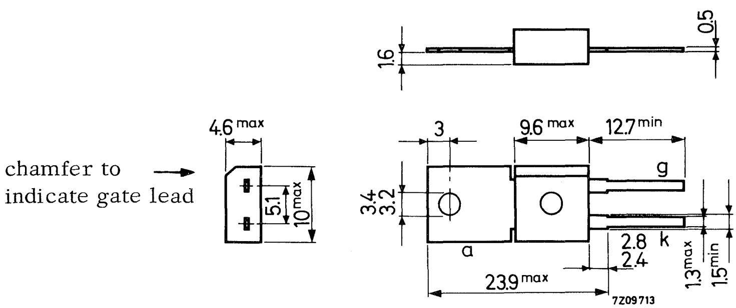
Plastic encapsulated p-gate silicon thyristors, intended for motor control in food mixers, sewing machines and hand drills, and for use in switching, ignition and starting systems. The series consists of the reverse polarity types: BT100A-300R; BT100A-500R.

QUICK REFERENCE DATA

			BT100A-300R	500R	
Crest working voltages	$V_{DWM} = V_{RWM}$	max.	200	400	V
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max.	300	500	V
Average on-state current up to T_{tab}=75 °C	$I_{T(AV)}$	max.	2		A
R.M.S. on-state current	$I_{T(RMS)}$	max.	4.5		A
Non-repetitive peak on-state current t = 10 ms; T_j = 100 °C prior to surge	I_{TSM}	max.	40		A
Junction temperature	T_j	max.	100		°C

MECHANICAL DATA

Dimensions in mm



All information applies to frequencies up to 400 Hz.

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

ANODE TO CATHODE

Voltages [1)]

			BT100A - 300R	500R	
Continuous reverse voltage	V_R	max.	200	400	V
Crest working voltages	$V_{DWM} = V_{RWM}$	max.	200	400	V
Repetitive peak voltages ($\delta \leq 0.01$)	$V_{DRM} = V_{RRM}$	max.	300	500	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	500	V
Continuous off-state voltage	V_D	max.	200	400	V
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	300	500	V

Currents (for overload conditions see curve on page 6)

Average on-state current (averaged over any 20 ms period) up to $T_{tab} = 75\ ^{o}C$	$I_{T(AV)}$	max.	2	A
On-state current (d.c.)	I_T	max.	4.5	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	4.5	A
Repetitive peak on-state current	I_{TRM}	max.	20	A
Non-repetitive peak on-state current ($t = 10$ ms; half sine wave) $T_j = 100\ ^{o}C$ prior to surge	I_{TSM}	max.	40	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	8	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 20$ A	$\frac{dI_T}{dt}$	max.	100	A/µs
Starting current		see page 5		

1) To ensure thermal stability: $R_{th\ j-a} < 37.5\ ^{o}C/W$ (d.c. blocking) or $< 60\ ^{o}C/W$ (a.c.)

RATINGS (continued)

GATE TO CATHODE

Voltages

Reverse peak voltage	V_{RGM}	max.	5	V
Current				
Forward peak current	I_{FGM}	max.	250	mA
Power dissipation				
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	100	mW
Peak power dissipation	P_{GM}	max.	1	W

TEMPERATURES

Storage temperature	T_{stg}	−40 to +100		^oC
Junction temperature	T_j	max.	100	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	75	$^oC/W$
From junction to tab	$R_{th\ j\text{-}tab}$	8	$^oC/W$
From tab to heatsink			
without heatsink compound	$R_{th\ tab\text{-}h}$	3	$^oC/W$
with heatsink compound, (e.g. Dow Corning 340)	$R_{th\ tab\text{-}h}$	1	$^oC/W$
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}tab}$	0.9	$^oC/W$ ←

CHARACTERISTICS

ANODE TO CATHODE

			BT100A - 300R	500R	
Voltages					
On-state voltage I_T = 5 A; T_j = 25 ^oC	V_T	<	1.4	1.4	V[1]
Rate of rise of off-state voltage that will not trigger any device; T_j = 100 ^oC	$\frac{dV_D}{dt}$	<	10	10	V/µs
Currents					
Peak reverse current at T_j = 100 ^oC $V_{RM} = V_{RWMmax}$	I_{RM}	<	2	1	mA
Peak off-state current at T_j = 100 ^oC $V_{DM} = V_{DWMmax}$	I_{DM}	<	2	1	mA
Latching current; T_j = 25 ^oC	I_L	typ.	10	10	mA
		<	40	40	mA
Holding current; T_j = 25 ^oC	I_H	typ.	4	4	mA
		<	15	15	mA

1) Measured under pulsed conditions to avoid excessive dissipation.

CHARACTERISTIC (continued)

GATE TO CATHODE

Voltages

Voltage that will trigger all devices

$V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	2	V
$V_D = 6$ V; $T_j = -40$ °C	V_{GT}	>	2.5	V

Voltage that will not trigger any device

$V_D = V_{DRMmax}$; $T_j = 100$ °C	V_{GD}	<	0.20	V

Current

Current that will trigger all devices

$V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	10	mA
$V_D = 6$ V; $T_j = -40$ °C	I_{GT}	>	15	mA

SWITCHING CHARACTERISTICS

Turn-on time when switched from

$V_D = V_{DWMmax}$ to $I_T = 3$ A Gate source 5 V; 100 Ω; $T_j = 25$ °C	t_{on}	typ.	1.3	μs

Turn-off time when switched from

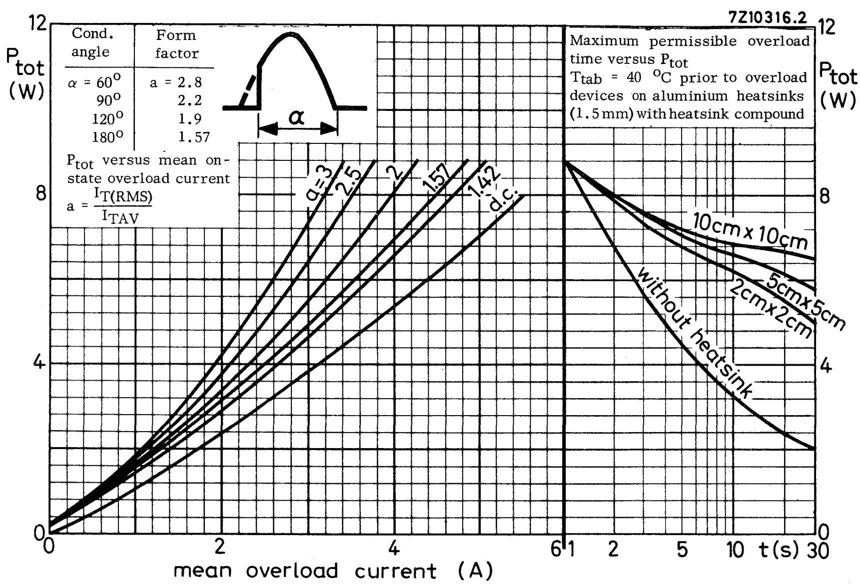
$I_T = 1$ A; $\frac{dV_D}{dt} = 10$ V/μs; $T_j = 25$ °C	t_q	typ.	10	μs

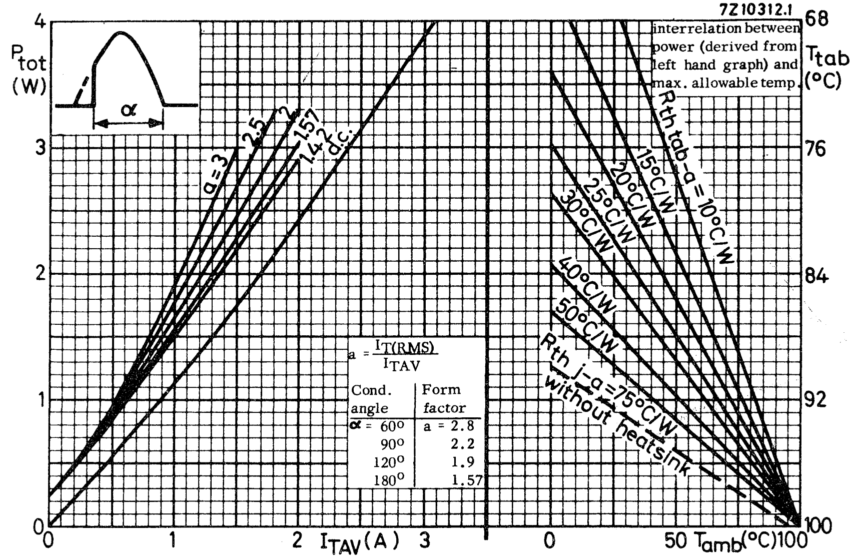
OPERATING NOTES

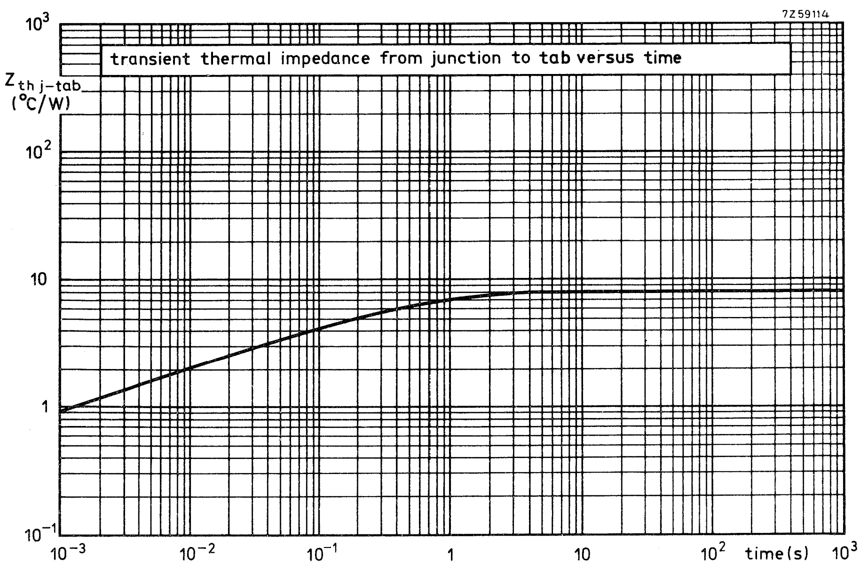
1. The thyristors may be soldered directly into the circuit but a thermal shunt should be used to keep heat conduction to the junction to a minimum.

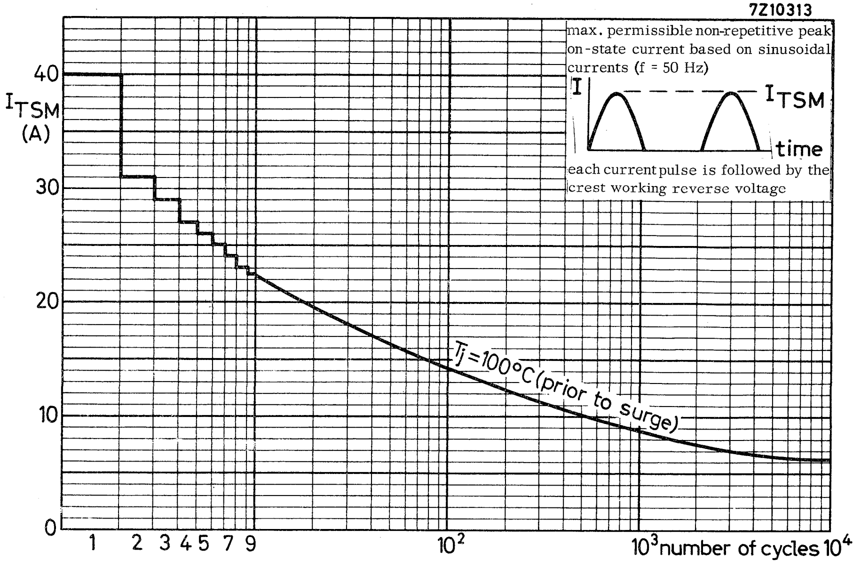
2. Overload conditions

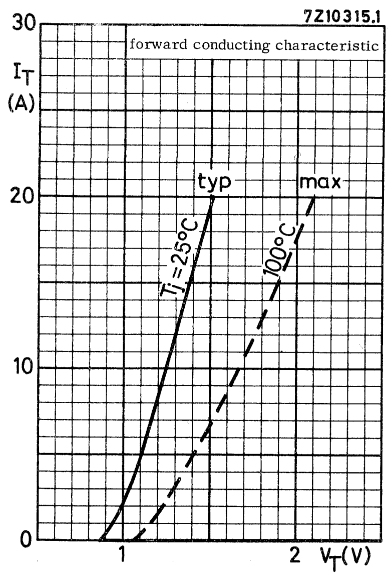
   The method of using the graph below is as follows:
   Starting with the curves of dissipation versus mean on-state overload current, for a particular current value trace upwards to meet the appropriate form factor curve. Then trace horizontally until the appropriate heatsink curve is reached. Finally trace downwards to determine the permitted overload time. After the permitted overload time the device must revert to normal operations as derived from the graph on page 6.

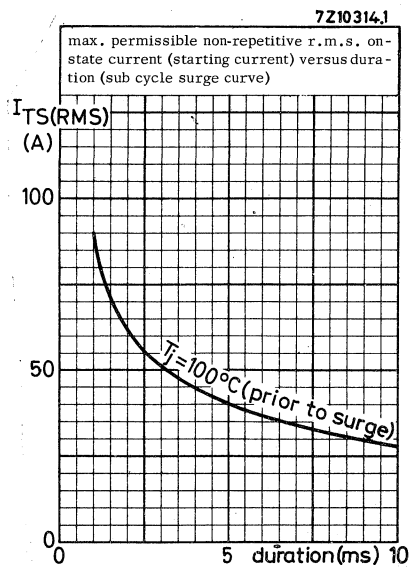



7Z10312.1
P_{tot} (W)
α
a=3
2.5
2
1.57
1.42
d.c.
$a = \frac{I_{T(RMS)}}{I_{TAV}}$
Cond. angle
Form factor
α = 60° a = 2.8
90° 2.2
120° 1.9
180° 1.57
I_{TAV} (A)
interrelation between power (derived from left hand graph) and max. allowable temp.
Rth tab-a = 10°C/W
15°C/W
20°C/W
25°C/W
30°C/W
40°C/W
50°C/W
Rth j-a = 75°C/W without heatsink
50 T_{amb} (°C) 100
T_{tab} (°C)
68
76
84
92
100


7Z59114
transient thermal impedance from junction to tab versus time
$Z_{th\ j-tab}$ (°C/W)
10^3
10^2
10
1
10^{-1}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
time (s)
10^3


7Z10313
max. permissible non-repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
I
ITSM
time
each current pulse is followed by the crest working reverse voltage
40
ITSM
(A)
30
20
10
0
1
2
3
4
5
7
9
10²
10³
number of cycles
10⁴
Tj=100°C (prior to surge)


7Z10315.1
forward conducting characteristic
30
IT
(A)
20
10
0
1
2
VT(V)
typ
max
Tj=25°C
100°C


7Z10314.1
max. permissible non-repetitive r.m.s. on-state current (starting current) versus duration (sub cycle surge curve)
ITS(RMS)
(A)
100
50
0
0
5
duration (ms)
10
Tj=100°C (prior to surge)

SILICON THYRISTORS

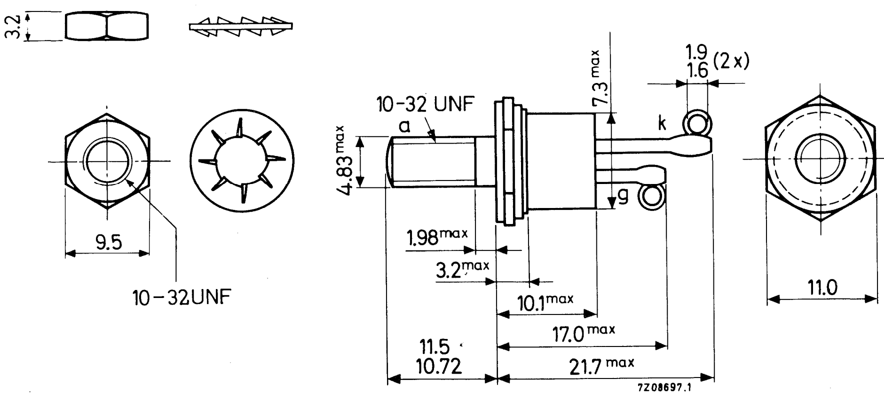
P-gate silicon thyristors in a TO-64 metal envelope, intended for use in domestic applications. The series consist of the reverse polarity types (stud-anode) BT101-300R; BT101-500R; BT102-300R and BT102-500R.
The BT101series has a higher triggering sensitivity.

QUICK REFERENCE DATA

			BT101; BT102-300R	500R	
Crest working reverse voltage	V_{RWM}	max.	200	400	V
Crest working off-state voltage	V_{DWM}	max.	200	400	V
Average on-state current (T_{mb} = 85 °C)	I_{TAV}	max.	6.5		A
R.M.S. on-state current	$I_{T(RMS)}$	max.	15		A
Non repetitive peak on-state current(t=10 ms)	I_{TSM}	max.	55		A
Junction temperature	T_j	max.	125		°C
Current to trigger all devices V_D = 6 V; T_j = 25 °C	BT101 I_{GT}	>	10		mA
	BT102 I_{GT}	>	50		mA

MECHANICAL DATA Dimensions in mm

TO-64



Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295, (56262A)

Torque on nut: min. 9 cmkg
max. 17 cmkg

All information applies to frequencies up to 400 Hz.

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

ANODE TO CATHODE

Voltages [1]

			BT101; BT102-300R	500R	
Crest working reverse voltage	V_{RWM}	max.	200	400	V
Repetitive peak reverse voltage ($\delta \leq 0.01$; f = 50 Hz)	V_{RRM}	max.	300	500	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	500	V
Crest working off-state voltage	V_{DWM}	max.	200	400	V
Repetitive peak off-state voltage ($\delta \leq 0.01$; f = 50 Hz)	V_{DRM}	max.	300	500	V
Non repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	300	500	V

Currents (for overload conditions see curve on page 8)

Average on-state current (averaged over any 20 ms period) T_{mb} = 85 °C	I_{TAV}	max.	6.5	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	15	A
Repetitive peak on-state current	I_{TRM}	max.	50	A
Non repetitive peak on-state current (t = 10 ms) (see also page 7)	I_{TSM}	max.	55	A
I squared t for fusing ($t \leq 10$ ms)	I^2t	max.	15	A^2s
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	50	A/μs
Starting current		see page 7		

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

1) These ratings apply to a gate voltage range of −5 to +0.25 V.
To ensure thermal stability: $R_{th\ j\text{-}a} \leq 20$ °C/W (d.c.) or ≤ 40 °C/W (a.c.).

RATINGS (continued)

Temperatures

Storage temperature	T_{stg}	−55 to +125	°C
Junction temperature	T_j	max. 125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	= 3	°C/W
From junction to ambient in free air with nut and washer	$R_{th\ j\text{-}a}$	= 40	°C/W
From mounting base to heatsink for a torque of 9 kg cm on the nut	$R_{th\ mb\text{-}h}$	= 0.5	°C/W

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltage

On-state voltage I_T = 20 A; T_j = 25 °C	V_T	< 2.3	V [1]

Currents

Reverse current $V_R = V_{RWMmax}$	I_R	< 1.5	mA
Off-state current $V_D = V_{DWMmax}$	I_D	< 1.5	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices			BT101	BT102	
V_D = 6 V; T_j = +25 °C	V_{GT}	>	2	2.5	V
V_D = 6 V; T_j = −10 °C	V_{GT}	>	2.1	2.8	V
Voltage not to trigger any device	V_{GD}	<	0.25		V

Current

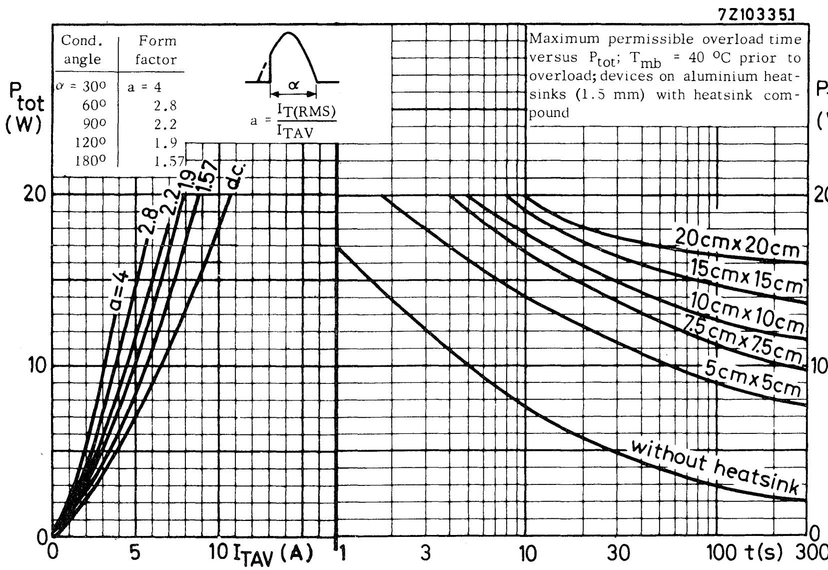
Current to trigger all devices			BT101	BT102	
V_D = 6 V; T_j = +25 °C	I_{GT}	>	10	50	mA
V_D = 6 V; T_j = −10 °C	I_{GT}	>	13	65	mA

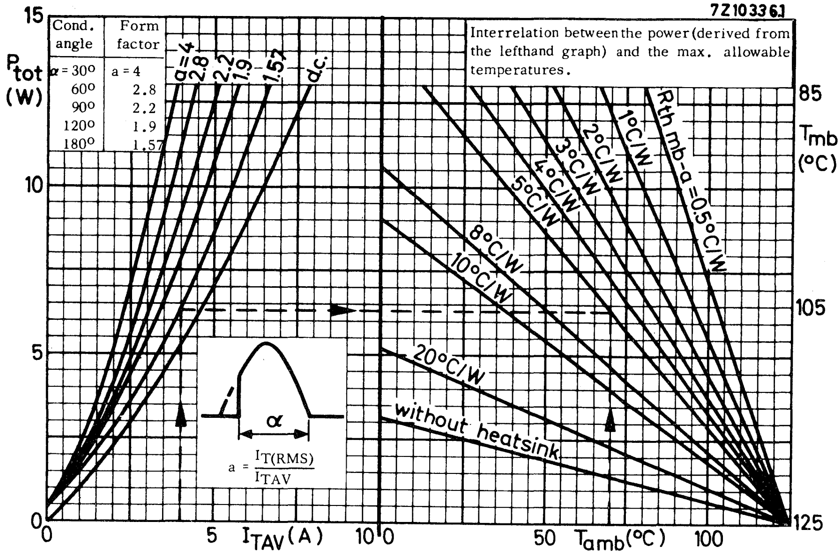
[1]) Measured under pulsed conditions to prevent excessive dissipation.

OPERATING NOTES (See also general pages at the beginning of this section)

1. The gate and cathode connectors should not be bent or twisted; they should be soldered into the circuit so that 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.
2. Overload conditions

   The method of using the graph below is as follows:
   Starting with the curves of dissipation versus mean on-state overload current, for a particular current value trace upwards to meet the appropriate form factor curve. Then trace horizontally until the appropriate heatsink curve is reached. Finally trace downwards to determine the permitted overload time. After the permitted overload time the device must revert to normal operation as derived from the graph on page 5.





Determination of the heatsink thermal resistance.

Example:

Assume a thyristor, used in a single phase rectifier circuit.

conduction angle	α	=	180°	
average forward current	I_{TAV}	=	4	A
ambient temperature	T_{amb}	=	70	°C

From the left hand part of the graph above it follows that at I_{TAV} = 4 A and α = 180° in a single phase rectifier circuit the average forward power + average leakage power = 6.4 W.

From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 6.4 W at T_{amb} = 70 °C

$$R_{th\ mb\text{-}a} \approx 5\ {}^{o}C/W$$

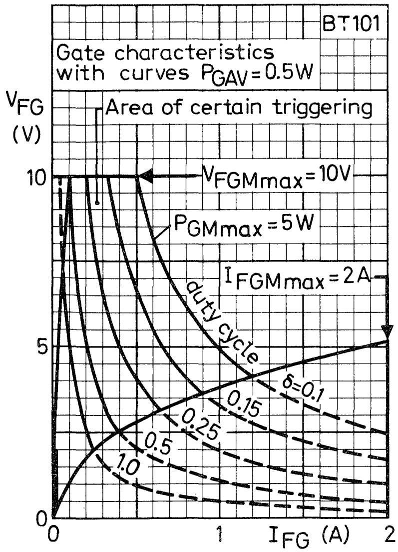
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.5 °C/W

Hence the heatsink thermal resistance should be:

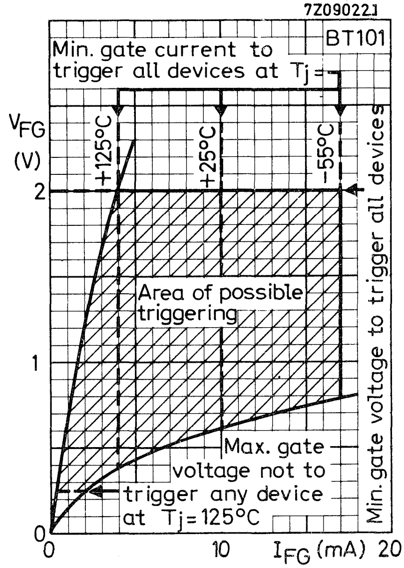
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (5 - 0.5)\ {}^{o}C/W = 4.5\ {}^{o}C/W$$

The applicable heatsink(s) may then be found in the section HEATSINKS.

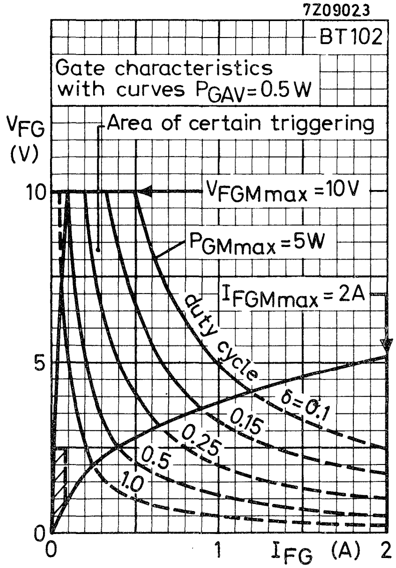
7Z09021



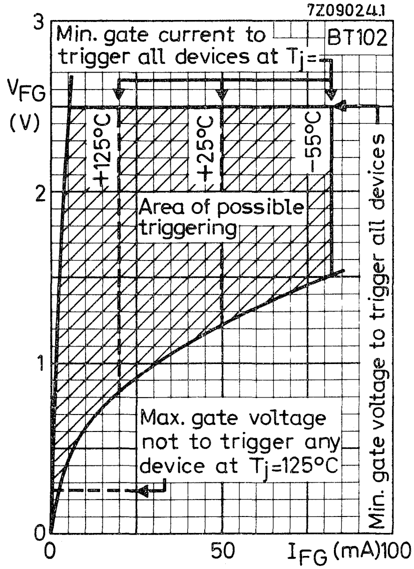
7Z09022.1

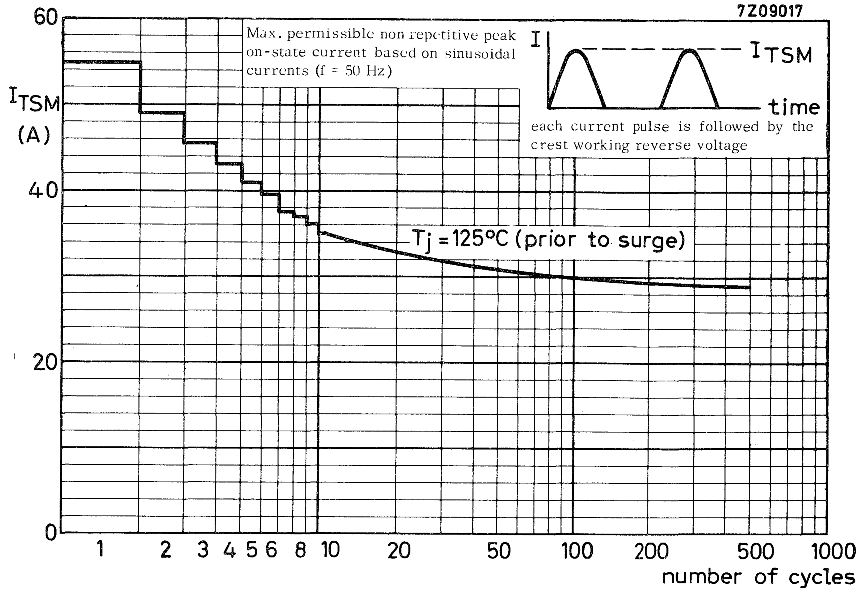


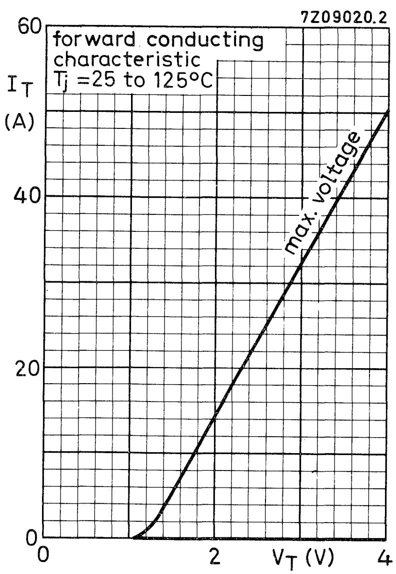
7Z09023

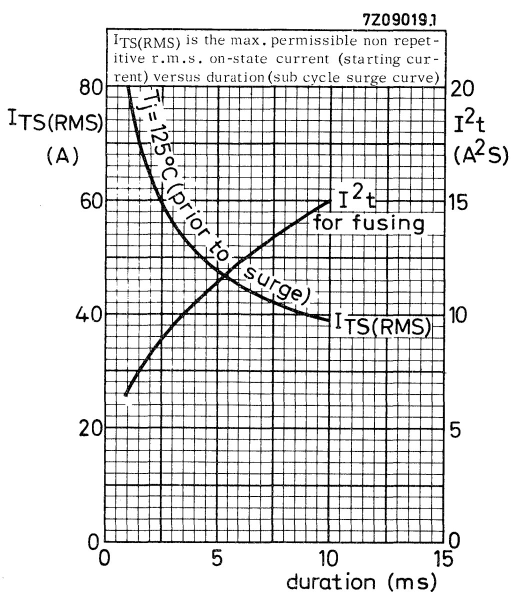


7Z09024.1




7Z09017
60
40
20
0
ITSM
(A)
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
I
ITSM
time
each current pulse is followed by the crest working reverse voltage
Tj =125°C (prior to surge)
1
2
3
4
5
6
8
10
20
50
100
200
500
1000
number of cycles


7Z09020.2
forward conducting characteristic
Tj =25 to 125°C
IT
(A)
60
40
20
0
0
2
4
VT (V)
max. voltage


7Z09019.1
ITS(RMS) is the max. permissible non repetitive r.m.s. on-state current (starting current) versus duration (sub cycle surge curve)
ITS(RMS)
(A)
80
60
40
20
0
I²t
(A²S)
20
15
10
5
0
Tj = 125°C (prior to surge)
I²t for fusing
ITS(RMS)
0
5
10
15
duration (ms)

SILICON THYRISTORS

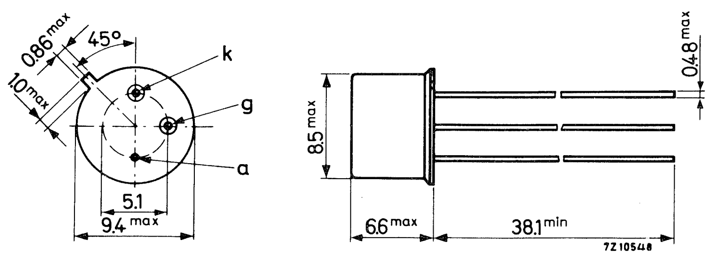
The BTX18series is a range of p-gate reverse blocking thyristors, in a TO-5 metal envelope, intended for use in general low power applications up to 1 A average on-state current

QUICK REFERENCE DATA								
			BTX18-100	200	300	400	500	
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	V
Average on-state current up to T_{case} = 105 °C	I_{TAV}	max.			1.0	A		
T_{amb} = 60 °C; in free air	I_{TAV}	max.			250	mA		
Junction temperature	T_j	max.			125	°C		
Thermal resistance from junction to case	$R_{th\ j\text{-}c}$	=			10	°C/W		
from junction to ambient	$R_{th\ j\text{-}a}$	=			200	°C/W		

MECHANICAL DATA Dimensions in mm

Anode connected to the case

TO-5



Accessories available: 56218; 56245; 56265

All information applies to frequencies up to 400 Hz

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

ANODE TO CATHODE

Voltages [1]			BTX18-100	200	300	400	500	
Continuous reverse voltage	V_R	max.	100	200	300	400	500	V
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	V
Repetitive peak reverse voltage (δ = 0.01; f = 50 Hz)	V_{RRM}	max.	120	240	350	500	600	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	120	240	350	500	600	V
Continuous off-state voltage	V_D	max.	100	200	300	400	500	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	V
Repetitive peak off-state voltage (δ = 0.01; f = 50 Hz)	V_{DRM}	max.	120	240	350	500	600	V [2]
Non repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	120	240	350	500	600	V [2]

Currents

Average on-state current up to T_{case} = 105 °C	I_{TAV}	max.	1.0	A
T_{amb} = 60 °C	I_{TAV}	max.	250	mA
On-state current (d.c.) T_{case} = 100 °C	I_T	max.	1.6	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	1.6	A
Repetitive peak on-state current	I_{TRM}	max.	10	A
Non repetitive peak on-state current (t = 10 ms, half sinewave)	I_{TSM}	max.	10	A

[1]) These ratings apply for zero or negative bias on the gate with respect to the cathode, and when a resistor $R \leq 1$ kΩ is connected between gate and cathode.

[2]) The device is not suitable for operation in the forward breakover mode.

RATINGS

GATE TO CATHODE (with 1 kΩ resistor between gate and 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.	0.2	A

Power dissipation

Average power dissipation	P_{GAV}	max.	0.05	W
Peak power dissipation	P_{GM}	max.	0.5	W

TEMPERATURES

Storage temperature	T_{stg}	−55 to +125	^{o}C
Junction temperature	T_j	125	^{o}C

THERMAL RESISTANCE

From junction to case	$R_{th\ j-c}$	=	10	$^{o}C/W$
From junction to ambient	$R_{th\ j-a}$	=	200	$^{o}C/W$
Transient thermal resistance (t = 10 ms)	$Z_{th\ j-c}$	=	2.5	$^{o}C/W$

CHARACTERISTICS (with 1 kΩ resistor between gate and cathode)

ANODE TO CATHODE

T_j = 125 ^{o}C unless otherwise specified

Voltages

			BTX18-100	200	300	400	500	
Forward on-state voltage I_T = 1.0 A; T_j = 25 ^{o}C [1]	V_T	<	1.5	1.5	1.5	1.5	1.5	V
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$		See page 6					

Currents

Reverse current $V_R = V_{RWMmax}$	I_R	<	800	400	275	200	160	μA
Off-state current $V_D = V_{DWMmax}$	I_D	<	800	400	275	200	160	μA

Pick-up current	I_P	typ.	10	mA
Holding current at T_j = 25 ^{o}C [2]	I_H	<	5.0	mA

[1] V_T is measured along the leads at 1 cm from the case.

[2] Measured under the following conditions: Anode supply voltage = + 6.0 V.
Initial on-state current after gate triggering = 50 mA.
The current is reduced until the device turns of.

CHARACTERISTICS (continued) T_j = 125 °C unless otherwise specified

GATE TO CATHODE

Voltages

Voltage to trigger all devices at T_j = 25 °C	V_{GT}	>	2.0	V
Voltage not to trigger any device	V_{GD}	<	200	mV

Current

Current to trigger all devices at T_j = 25 °C	I_{GT}	>	5.0	mA

SWITCHING CHARACTERISTICS

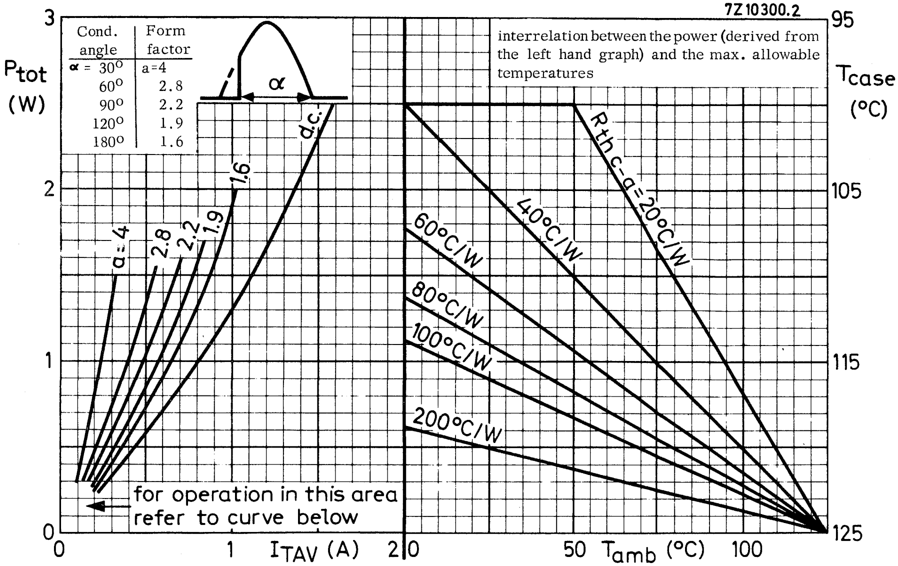
Turn off time when switched from

I_T = 300 mA to I_R = 175 mA; T_j = 25 °C	t_q	typ.	20	μs
T_j = 125 °C	t_q	typ.	35	μs

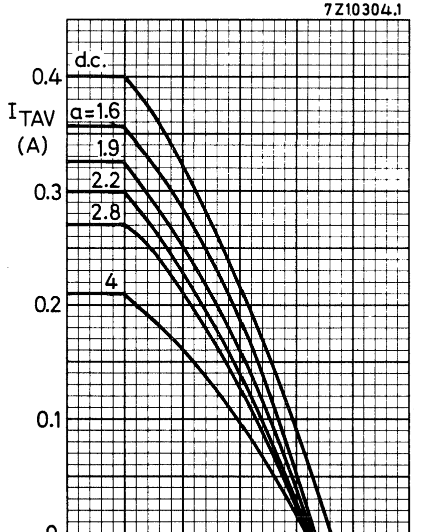
NOTES

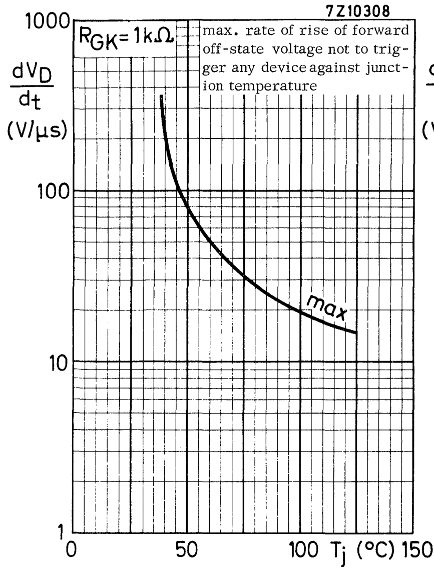
1. When using a soldering iron the thyristor may be soldered directly into the circuit, but the heat conduction to the junction should be kept to a minimum by using a thermal shunt.
2. Thyristors may be dip soldered at a solder temperature of 245 °C, for a maximum soldering time of 5 seconds. The case temperature during dip soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a thyristor mounted flush on a board with punched-through holes, or spaced 1.5 mm above a board having plated-through holes.
3. Care should be taken not to bend the leads nearer than 1.5 mm from the seal.

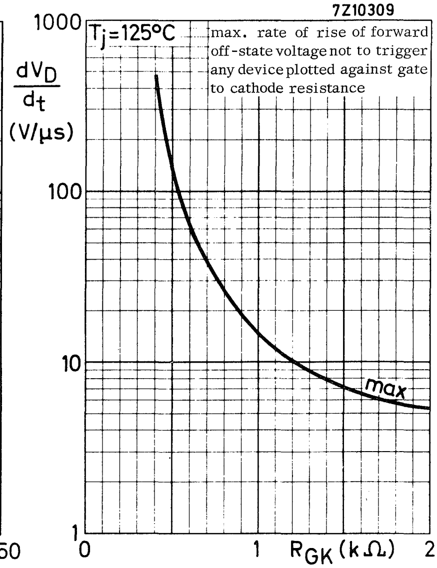
7Z10300.2

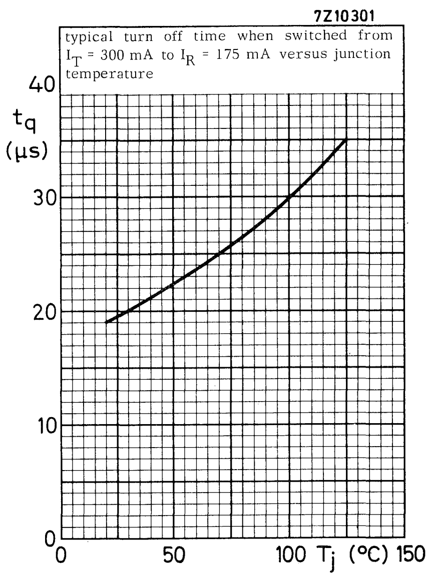


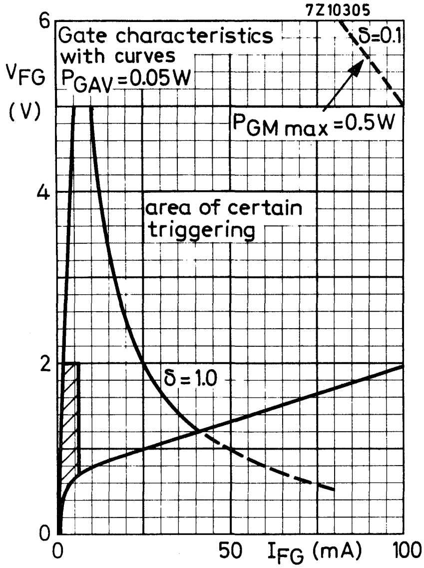
7Z10304.1

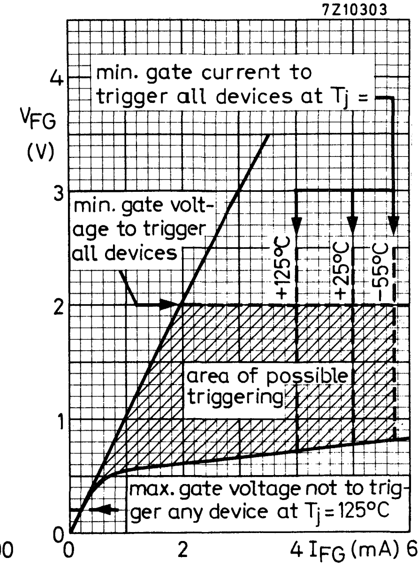


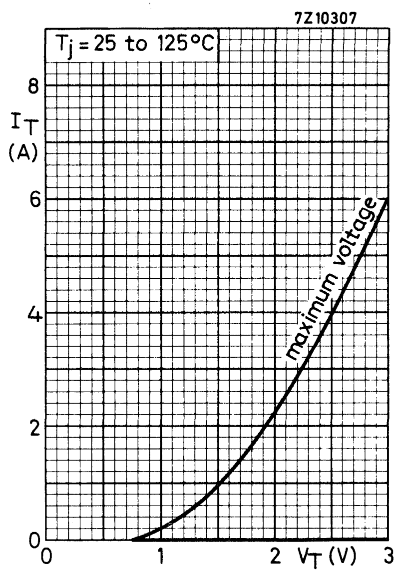

7Z10308
$R_{GK} = 1k\Omega$
max. rate of rise of forward off-state voltage not to trigger any device against junction temperature
1000
$\frac{dV_D}{dt}$
(V/µs)
100
10
1
max
0
50
100 T_j (°C) 150

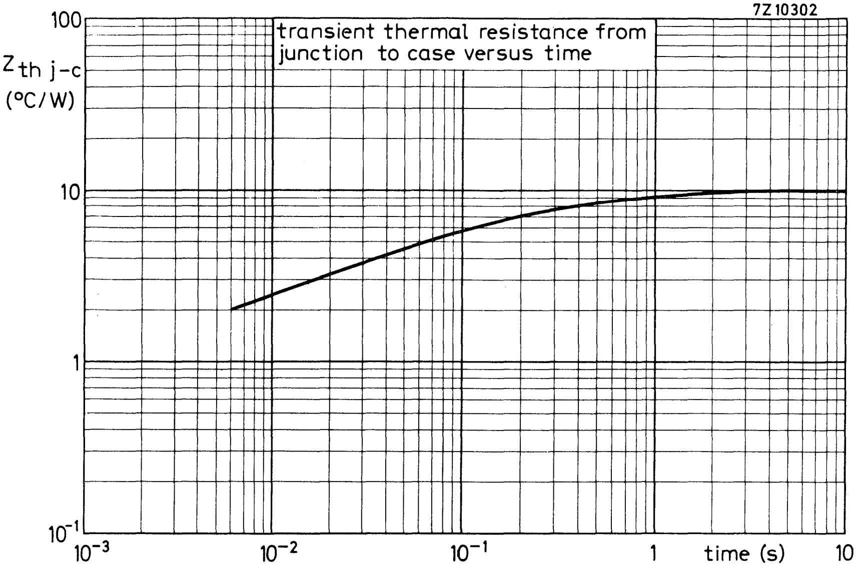

7Z10309
$T_j = 125°C$
max. rate of rise of forward off-state voltage not to trigger any device plotted against gate to cathode resistance
1000
$\frac{dV_D}{dt}$
(V/µs)
100
10
1
max
0
1
R_{GK} (kΩ)
2

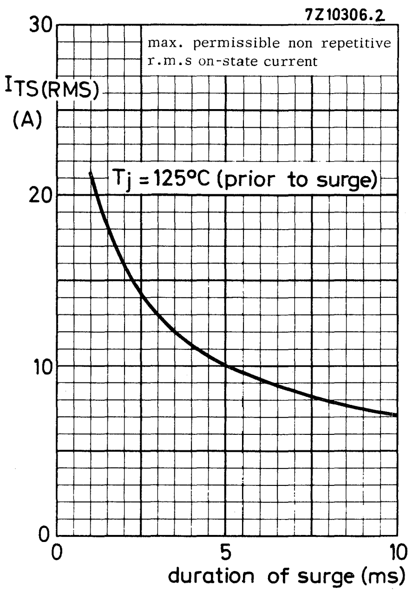

7Z10301
typical turn off time when switched from I_T = 300 mA to I_R = 175 mA versus junction temperature
40
t_q
(µs)
30
20
10
0
0
50
100 T_j (°C) 150


7Z10305
Gate characteristics with curves P_{GAV} = 0.05 W
δ=0.1
$P_{GM\ max}$ = 0.5 W
area of certain triggering
δ = 1.0
V_{FG} (V)
I_{FG} (mA)
6
4
2
0
0
50
100


7Z10303
min. gate current to trigger all devices at T_j =
min. gate voltage to trigger all devices
+125°C
+25°C
−55°C
area of possible triggering
max. gate voltage not to trigger any device at T_j = 125°C
V_{FG} (V)
I_{FG} (mA)
4
3
2
1
0
0
2
4
6


7Z10307
T_j = 25 to 125°C
maximum voltage
I_T (A)
V_T (V)
8
6
4
2
0
0
1
2
3


7Z10302
transient thermal resistance from junction to case versus time
$Z_{th\ j-c}$ (°C/W)
100
10
1
10^{-1}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10


7Z10306.2
max. permissible non repetitive r.m.s on-state current
$I_{TS(RMS)}$ (A)
T_j = 125°C (prior to surge)
30
20
10
0
0
5
10
duration of surge (ms)

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 reverse polarity types (stud anode) BTX35-500R to -800R

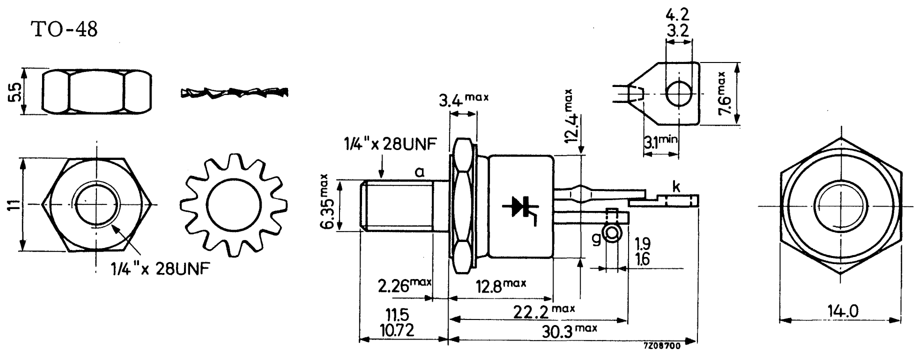
QUICK REFERENCE DATA

			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 at T_{mb} = 75 °C	I_{TAV}	max.	12				A
T_{mb} = 85 °C	I_{TAV}	max.	10				A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	140				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	$R_{th\ j\text{-}mb}$	=	1.6				°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

Diameter of hole in heatsink: max. 6.5 mm
Accessories available: 56264A

All information applies to frequencies up to 400 Hz

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

ANODE TO CATHODE

Voltages [1]		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 2)

Currents

Average forward current (averaged over any 20 ms period) T_{mb} = 75 °C	I_{TAV}	max.	12	A
T_{mb} = 85 °C	I_{TAV}	max.	10	A
Forward current (d.c.)	I_T	max.	19	A
R.M.S. forward current	$I_{T(RMS)}$	max.	19	A
Repetitive peak forward current	I_{TRM}	max.	140	A
Non repetitive peak forward current t = 10 ms (See also page 8)	I_{TSM}	max.	140	A
I squared t for fusing (t = 1.5 to 10 ms)	I^2t	max.	100	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/μs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

Power dissipation

Non repetitive peak reverse dissipation (See also page 7) 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) These ratings apply to a gate voltage range of −5 to +0.20 V
To ensure thermal stability: $R_{th\ j\text{-}a} \leq 4.5$ °C/W (d.c.) or ≤ 9 °C/W (a.c.)

2) 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.

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	$R_{th\ j\text{-}mb}$	=	1.6	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^oC/W$
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	4.0	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.1	$^oC/W$

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 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				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}	<	0.20	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 +0.20 V.

SWITCHING CHARACTERISTICS

Turn-on time when switched from

V_D = 400 V to I_T = 50 A

Gate source 5V, 25 Ω; T_j = 125 °C	t_{on}	typ.	2.0	μs

Turn-off time when switched from

I_T = 10 A to $V_R \geq$ 50 V

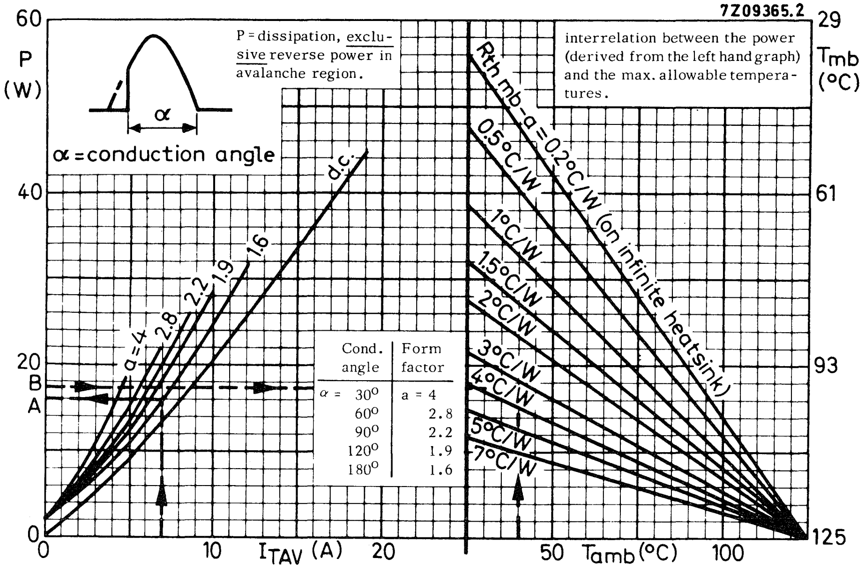
with -dI/dt = 10 A/μs; dV_D/dt = 10 V/μs

T_j = 125 °C	t_q	<	100	μs
T_j = 25 °C	t_q	<	50	μs

OPERATING NOTES

See general pages at the beginning of this section.

The gate and cathode connectors should not be bent; they should be soldered into the circuit so that 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.



Determination of the heatsink thermal resistance

Example:

Assume a thyristor, used in a single phase full wave rectifier circuit.

conduction angle	α	=	180^{o}	
average forward current	I_{TAV}	=	7	A (per thyristor)
ambient temperature	T_{amb}	=	40	^{o}C
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	=	2	kW (per thyristor)
duration of P_{RRM}	t	=	10	μs

From the left hand part of the graph above it follows that at $I_{TAV} = 7$ A and $\alpha = 180^{o}$ the average forward power + average leakage power = 16 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 $P_{tot} = (16 + 1)$ W = 17 W (point B).

From the right hand part of the graph above follows the thermal resistance, required for $P_{tot} = 17$ W at $T_{amb} = 40\ ^{o}C$.

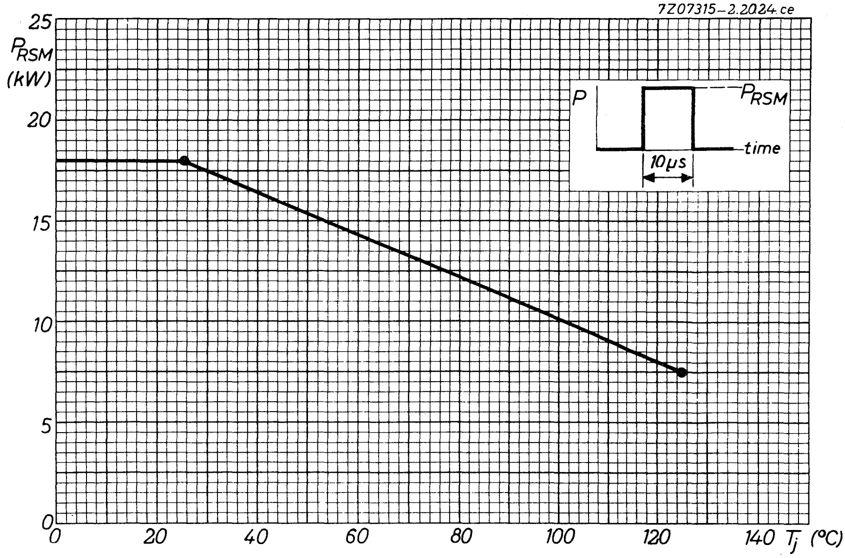
$$R_{th\ mb\text{-}a} \approx 3.5\ ^{o}C/W$$

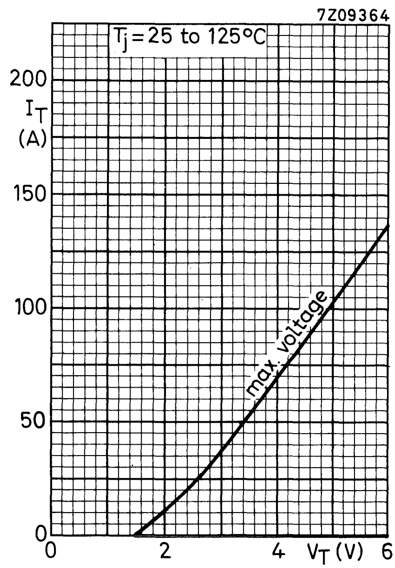
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.2\ ^{o}C/W$

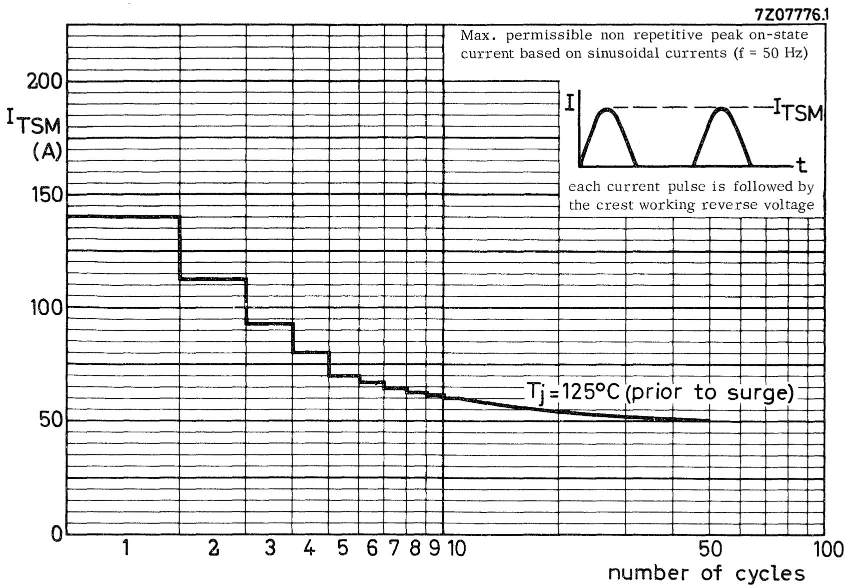
Hence the heatsink thermal resistance should be:

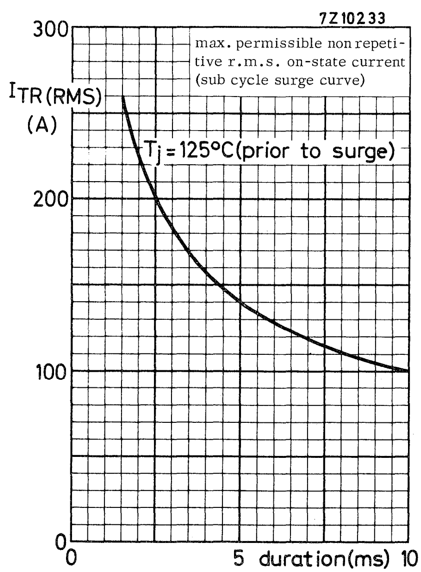
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (3.5 - 0.2)\ ^{o}C/W = 3.3\ ^{o}C/W.$$

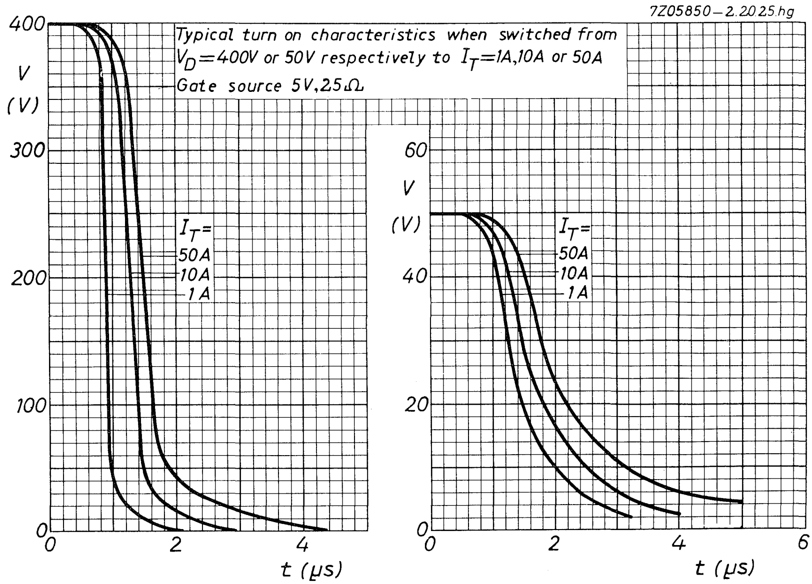
The applicable heatsink(s) may then be found in the Section HEATSINKS.

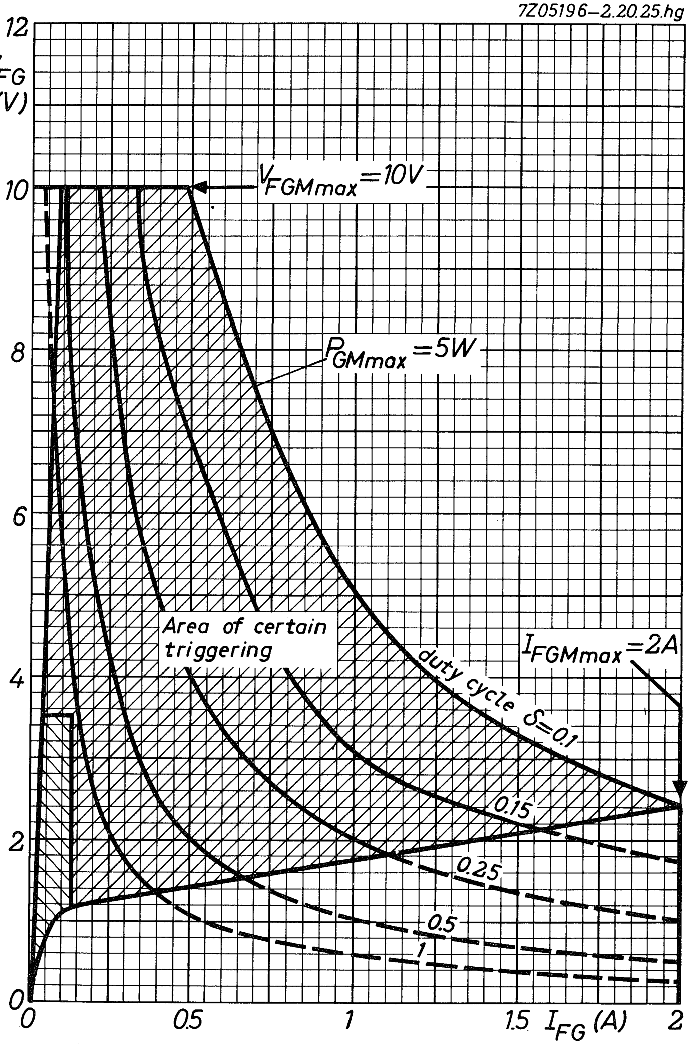

7Z07315–2.20.24.ce
25
P_{RSM}
(kW)
20
15
10
5
0
0
20
40
60
80
100
120
140 T_j (°C)
P
P_{RSM}
time
10μs


7Z09364
T_j = 25 to 125°C
200
I_T
(A)
150
100
50
0
0
2
4
V_T (V)
6
max. voltage

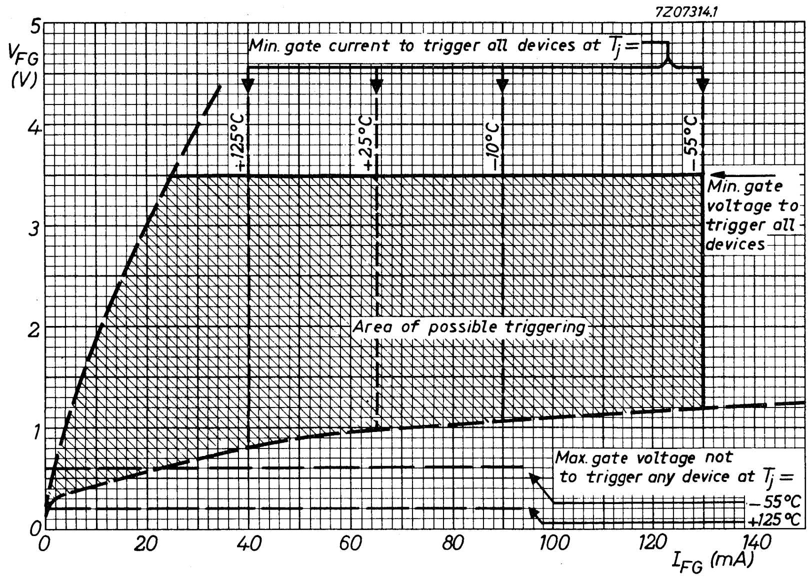

7Z07776.1
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
I
I TSM
t
each current pulse is followed by the crest working reverse voltage
200
I TSM
(A)
150
100
50
0
Tj = 125°C (prior to surge)
1
2
3
4
5
6
7
8
9
10
50
100
number of cycles

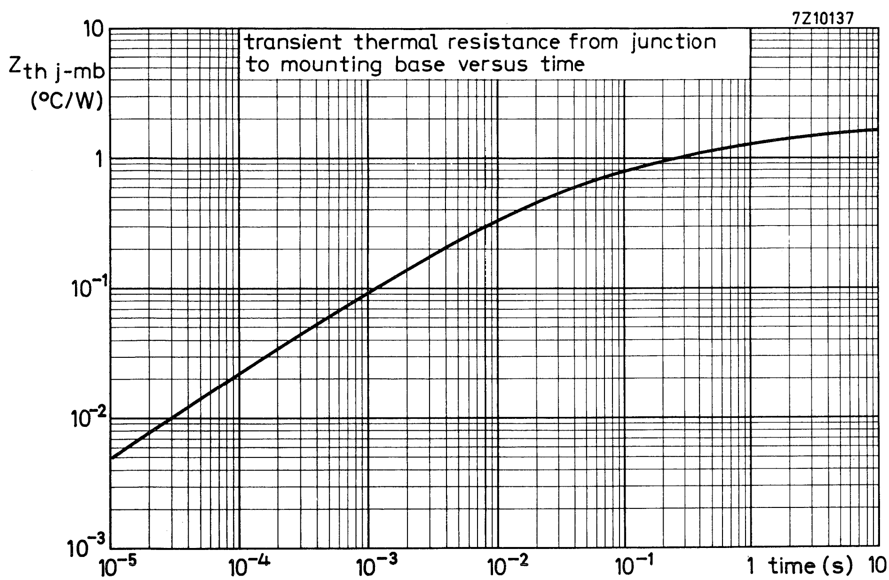

7Z10233
max. permissible non repetitive r.m.s. on-state current (sub cycle surge curve)
300
I TR (RMS)
(A)
200
100
0
Tj = 125°C(prior to surge)
0
5
duration(ms)
10

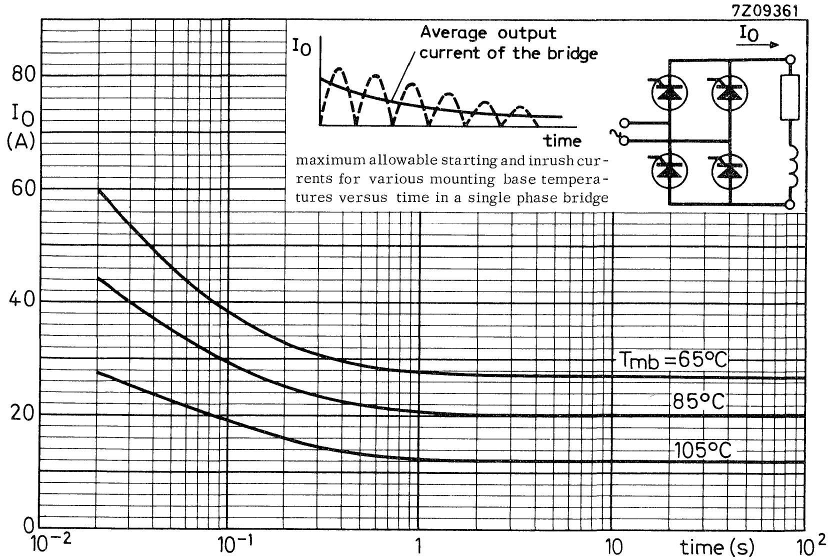

7Z05850—2.20.25.hg
Typical turn on characteristics when switched from
V_D=400V or 50V respectively to I_T=1A,10A or 50A
Gate source 5V,25Ω
400
V
(V)
300
200
100
0
I_T=
50A
10A
1 A
0
2
4
t (μs)
60
V
(V)
40
20
0
I_T=
50A
10A
1 A
0
2
4
6
t (μs)

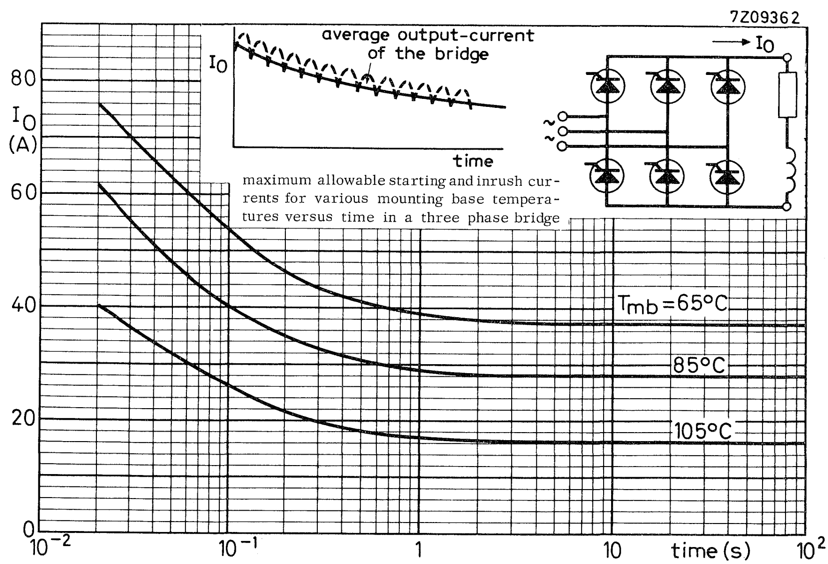


Gate characteristics with curves P_{GAV}=0.5W


7Z07314.1
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 =
−55°C
+125°C
I_{FG} (mA)
0
20
40
60
80
100
120
140
1
2
3
4
5


7Z10137
$Z_{th\ j\text{-}mb}$ (°C/W)
transient thermal resistance from junction to mounting base versus time
time (s)
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{-3}
10^{-2}
10^{-1}


7Z09361
Average output
current of the bridge
I_O
time
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a single phase bridge
80
I_O
(A)
60
40
20
0
T_{mb} = 65°C
85°C
105°C
10^{-2}
10^{-1}
1
10
time (s)
10^2


7Z09362
average output-current
of the bridge
I_O
time
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a three phase bridge
80
I_O
(A)
60
40
20
0
T_{mb} = 65°C
85°C
105°C
10^{-2}
10^{-1}
1
10
time (s)
10^2

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 reverse polarity types (stud anode) BTX36-500R to 800R

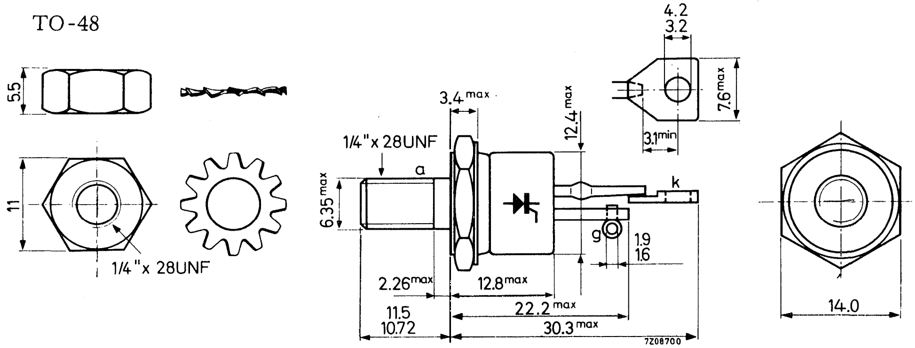
QUICK REFERENCE DATA

			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 at $T_{mb} = 77\,^oC$	I_{TAV}	max.	16				A
$T_{mb} = 85\,^oC$	I_{TAV}	max.	14				A
Non repetitive peak forward current $t = 10$ ms	I_{TSM}	max.	200				A
Non repetitive peak reverse dissipation $t = 10\,\mu s$; $T_j = 25\,^oC$	P_{RSM}	max.	18				kW
Junction temperature	T_j	max.	125				^oC
Thermal resistance from junction to mounting base	$R_{th\,j\text{-}mb}$	=	1.6				$^oC/W$

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

Diameter of hole in heatsink: max. 6.5 mm

Accessories available: 56264A

All information applies to frequencies up to 400 Hz

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

ANODE TO CATHODE

Voltages 1)

			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 2)

Currents

Average forward current (averaged over any 20 ms period) $T_{mb} = 77\ ^{o}C$	I_{TAV}	max.	16	A
$T_{mb} = 85\ ^{o}C$	I_{TAV}	max.	14	A
Forward current (d.c.)	I_T	max.	25	A
R.M.S. forward current	$I_{T(RMS)}$	max.	25	A
Repetitive peak forward current	I_{TRM}	max.	200	A
Non repetitive peak forward current t = 10 ms (See also page 8)	I_{TSM}	max.	200	A
I squared t for fusing (t = 1.5 to 10 ms)	I^2t	max.	200	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/μs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

Power dissipation

Non repetitive peak reverse dissipation (See also page 7) t = 10 μs; T_j = 25 ^{o}C	P_{RSM}	max.	18	kW
t = 10 μs; T_j = 125 ^{o}C	P_{RSM}	max.	7.5	kW

1) These ratings apply to a gate voltage range of −5 to +0.20 V.
To ensure thermal stability: $R_{th\ j\text{-}a} \leq 4.5\ ^{o}C/W$ (d.c.) or $\leq 9\ ^{o}C/W$ (a.c.)

2) 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.

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	$R_{th\ j\text{-}mb}$	=	1.6	°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
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.1	°C/W

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 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}	<	0.20	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 +0.20 V.

SWITCHING CHARACTERISTICS

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 $V_R \geq$ 50 V

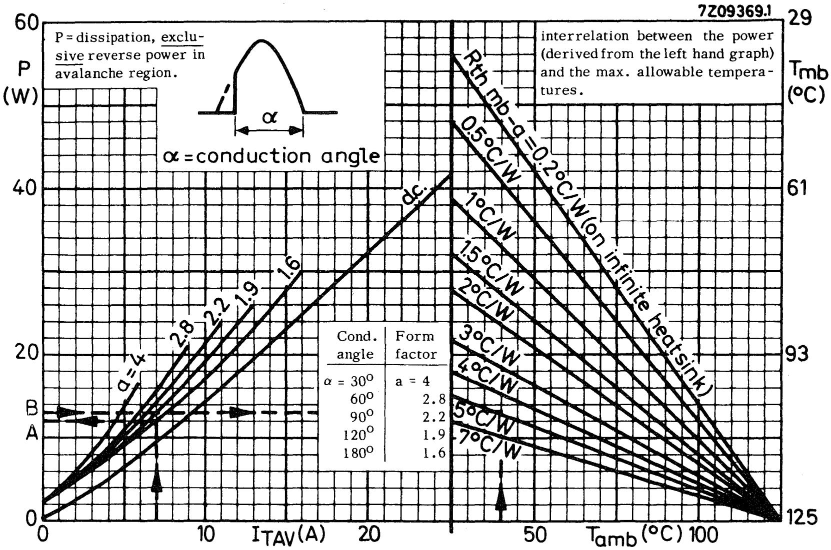
with -dI/dt = 10 A/µs; dV_D/dt = 10 V/µs

T_j = 125 °C	t_q	<	100	µs
T_j = 25 °C	t_q	<	50	µs

OPERATING NOTES

See general pages at the beginning of this section.

The gate and cathode connectors should not be bent; they should be soldered into the circuit so that 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.



Determination of the heatsink thermal resistance.

Example:
Assume a thyristor, used in a single phase full wave rectifier circuit.

conduction angle	α	=	180°
average forward current	I_{TAV}	=	7 A (per thyristor)
ambient temperature	T_{amb}	=	40 °C
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	=	2 kW (per thyristor)
duration of P_{RRM}	t	=	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 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 $P_{tot} = (12 + 1)\ W = 13\ W$ (point B).

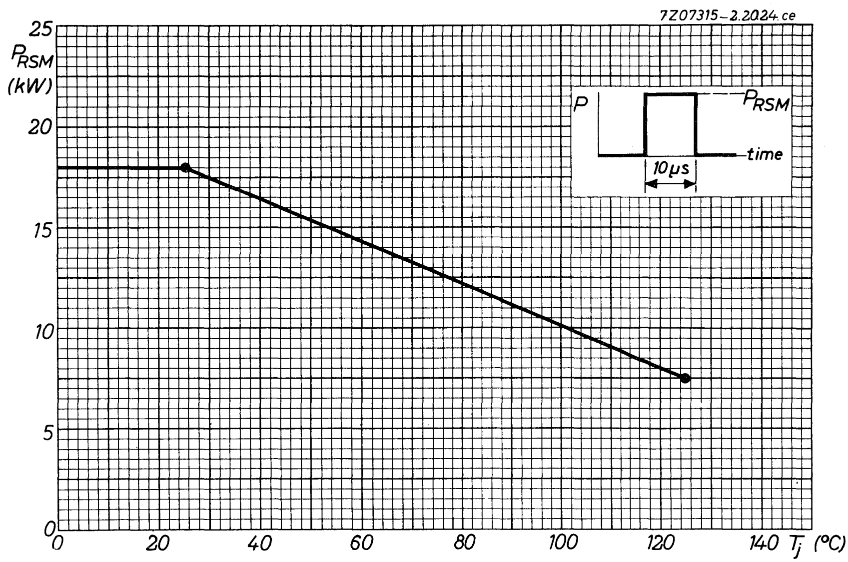
From the right hand part of the graph above follows the thermal resistance, required for $P_{tot} = 13\ W$ at $T_{amb} = 40\ ^oC$

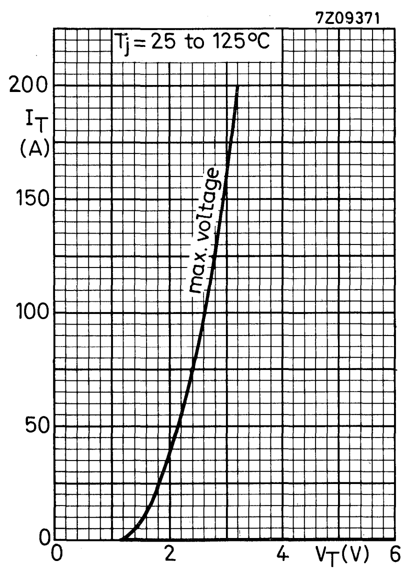
$$R_{th\ mb\text{-}a} \approx 5\ ^oC/W$$

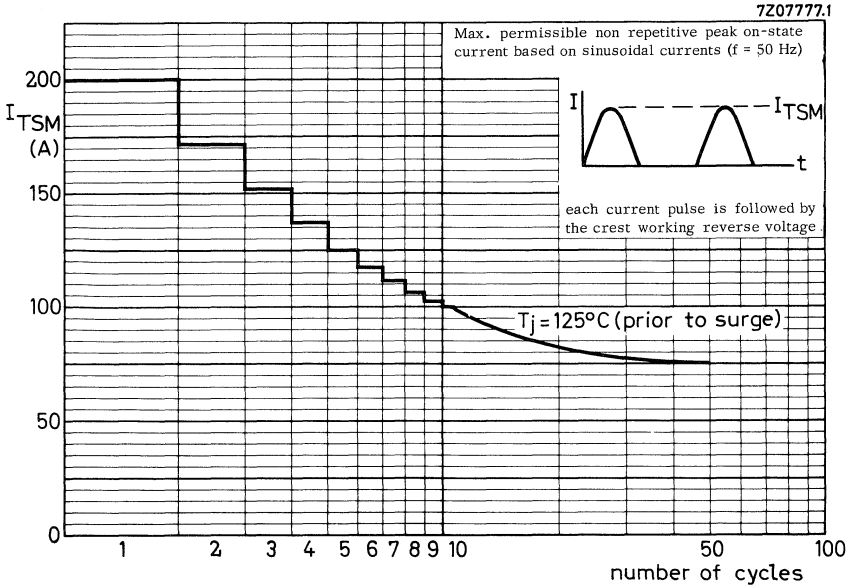
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.2\ ^oC/W$.
Hence the heatsink thermal resistance should be:

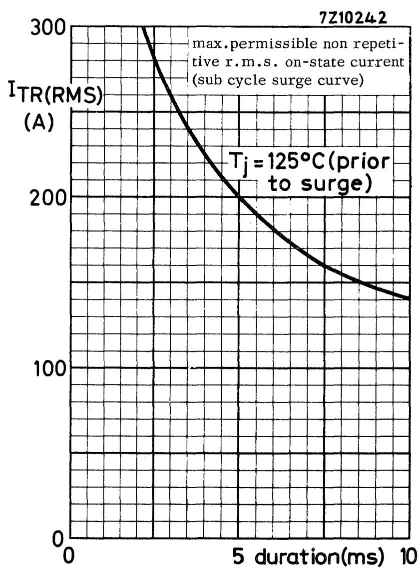
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (5 - 0.2)\ ^oC/W = 4.8\ ^oC/W.$$

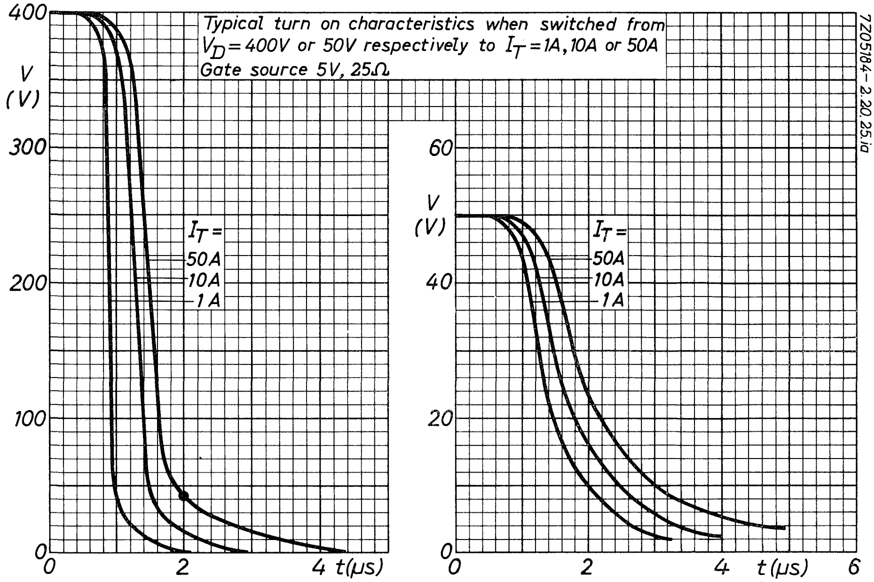
The applicable heatsink(s) may then be found in the Section HEATSINKS.

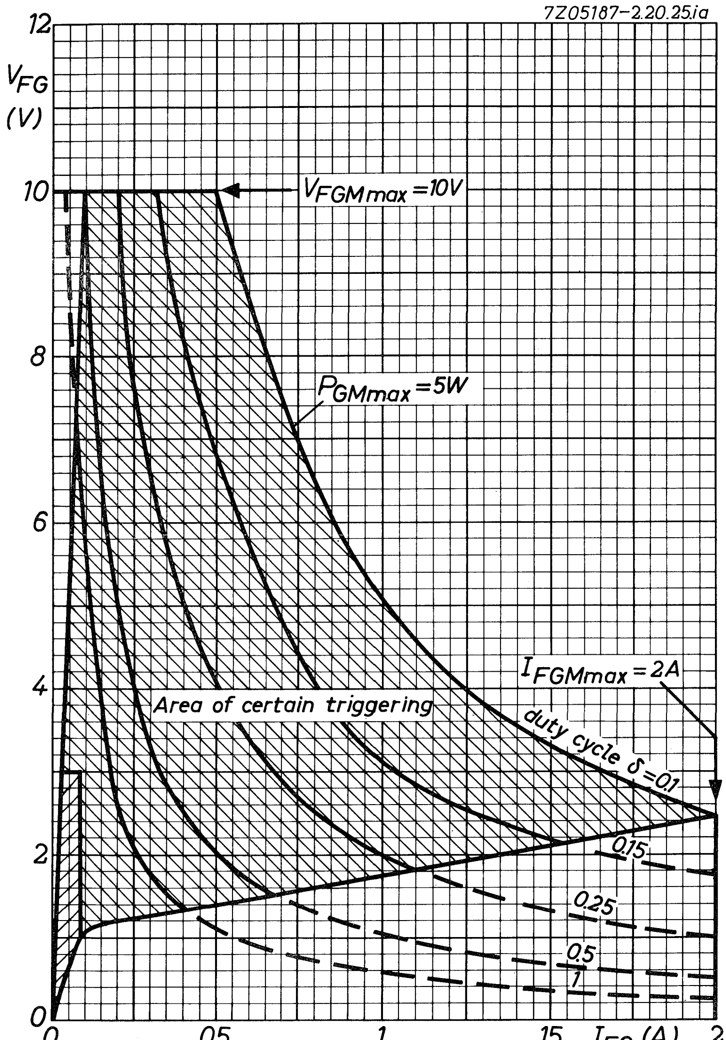

7Z07315-2.2024.ce
25
P_{RSM}
(kW)
20
15
10
5
0
P
P_{RSM}
time
10 μs
0
20
40
60
80
100
120
140 T_j (°C)


7Z09371
T_j = 25 to 125°C
200
I_T
(A)
150
100
50
0
max. voltage
0
2
4
V_T(V)
6

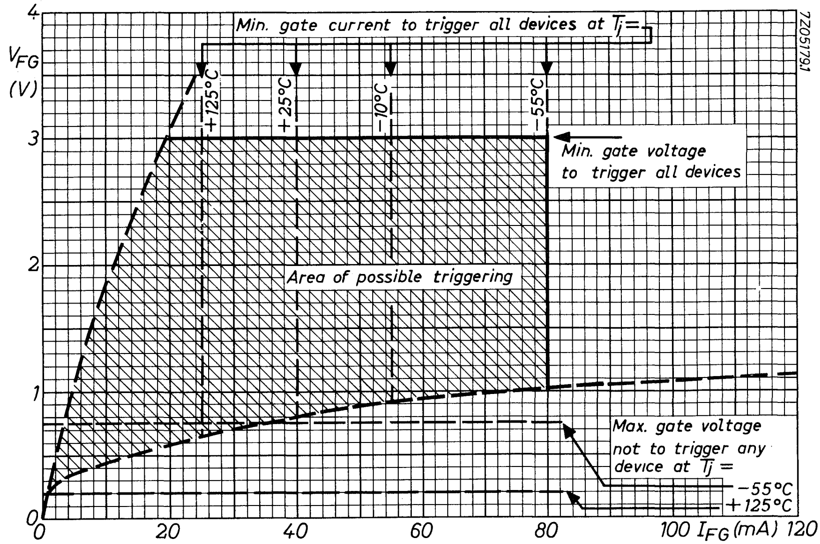

7Z07777.1
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
each current pulse is followed by the crest working reverse voltage
I
ITSM
t
200
150
100
50
0
ITSM
(A)
Tj = 125°C (prior to surge)
1
2
3
4
5
6
7
8
9
10
50
100
number of cycles

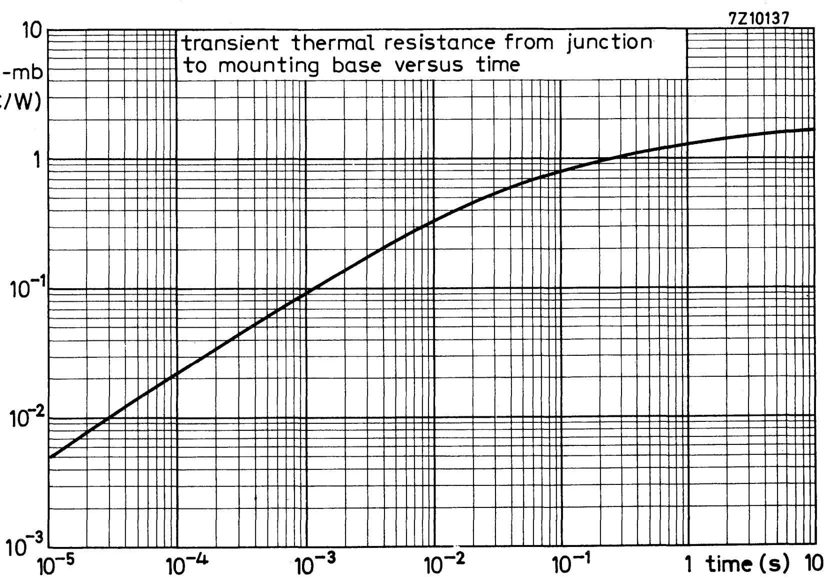

7Z10242
max.permissible non repetitive r.m.s. on-state current (sub cycle surge curve)
ITR(RMS)
(A)
300
200
100
0
Tj = 125°C (prior to surge)
0
5
duration(ms)
10

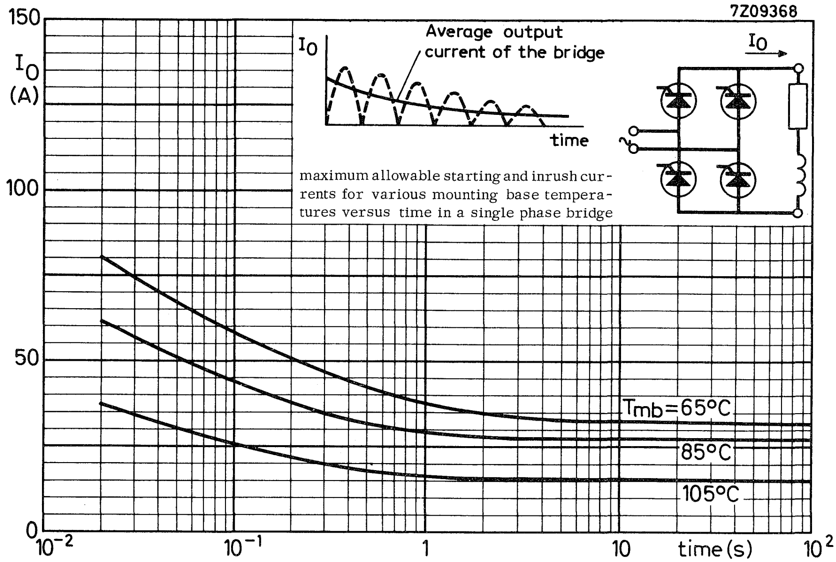

Typical turn on characteristics when switched from
V_D = 400V or 50V respectively to I_T = 1A, 10A or 50A
Gate source 5V, 25Ω
7Z05184–2.20.25.ia
V
(V)
400
300
200
100
0
I_T =
50A
10A
1 A
0
2
4 t(μs)
60
40
20
0
2
4
6

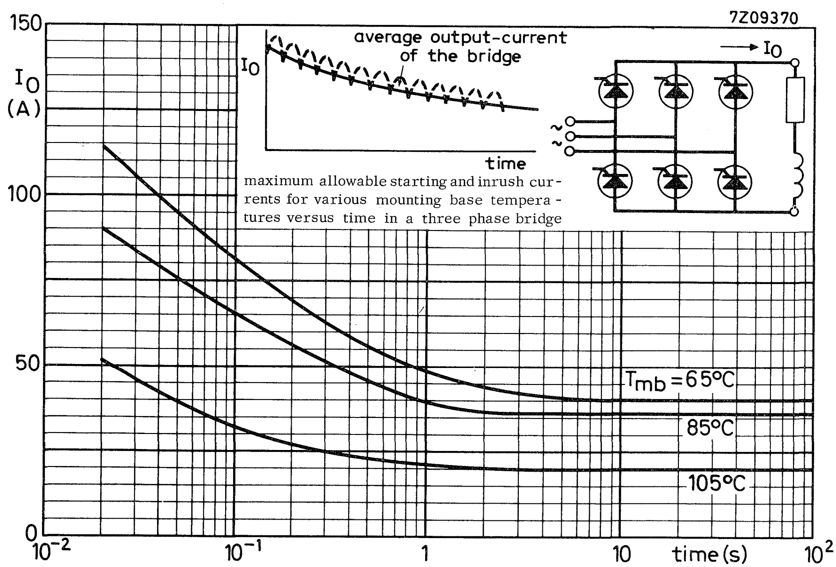


Gate characteristics with curves P_{GAV} = 0.5W


7Z05179.1
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 =
−55°C
+125°C
I_{FG} (mA)
0
20
40
60
80
100
120
1
2
3
4


7Z10137
transient thermal resistance from junction
to mounting base versus time
$Z_{th\ j\text{-}mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10


7Z09368
150
I_O
(A)
100
50
0
Average output
current of the bridge
time
I_O
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a single phase bridge
T_{mb}=65°C
85°C
105°C
10^{-2}
10^{-1}
1
10
time (s)
10^2


7Z09370
150
I_O
(A)
100
50
0
average output-current
of the bridge
time
I_O
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a three phase bridge
T_{mb}=65°C
85°C
105°C
10^{-2}
10^{-1}
1
10
time (s)
10^2

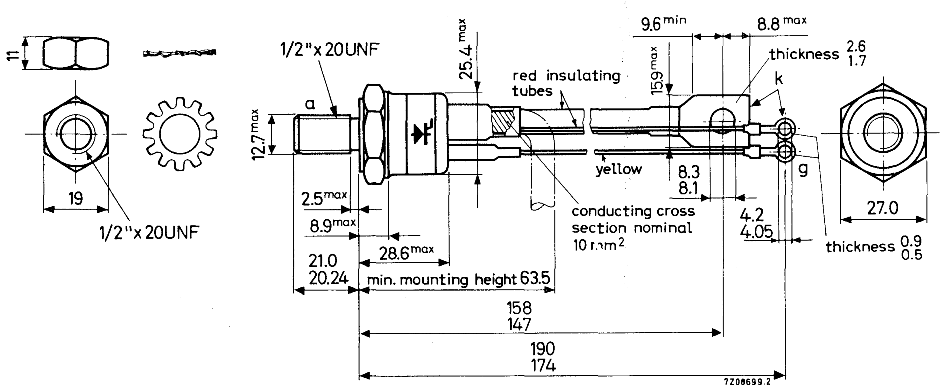
CONTROLLED AVALANCHE THYRISTORS

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 reverse polarity types (anode to stud) BTX37-500R to 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

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
R.M.S. forward current	$I_{T(RMS)}$	max.	78	A
Repetitive peak forward current	I_{TRM}	max.	700	A
Non repetitive peak forward current t = 10 ms (See also page 7)	I_{TSM}	max.	680	A
I squared t for fusing (t = 1.5 to 10 ms)	I^2t	max.	2000	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/μs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	30	A

Power dissipation

Non repetitive peak reverse dissipation (See also page 7) t = 10 μs; T_j = 25 °C	P_{RSM}	max.	40	kW
t = 10 μs; T_j = 125 °C	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
To ensure thermal stability: $R_{th\ j\text{-}a} \leq 1.5$ °C/W (d.c.) or ≤ 3 °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.

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	$R_{th\ j\text{-}mb}$	=	0.6	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	°C/W
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.02	°C/W

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTX37-500R	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	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

			BTX37-500R	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	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) The I_R values apply to a gate voltage range of −5 to +0.25 V.

SWITCHING CHARACTERISTICS (See also page 10)

Turn-on time when switched from
V_D = 400 V to I_T = 50 A

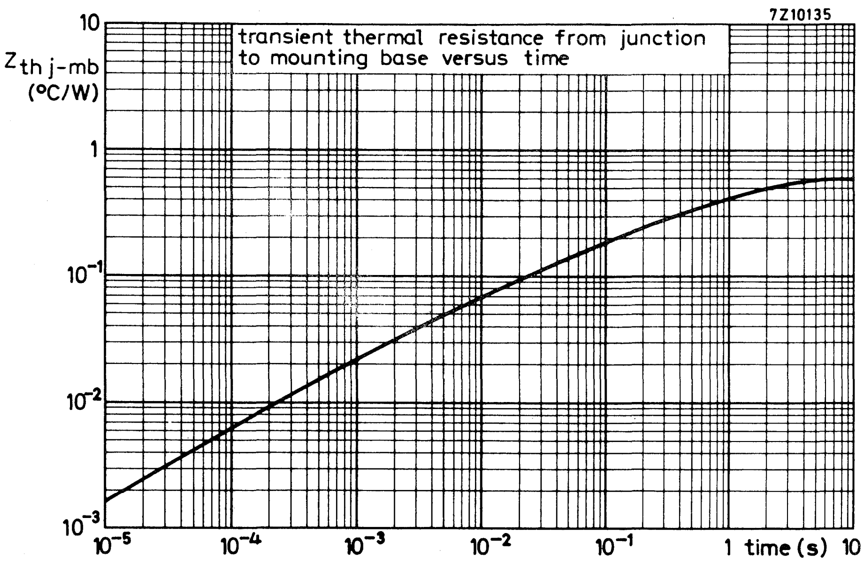
Gate source 5 V , 25 Ω, T_j = 125 °C	t_{on}	typ.	3.0 µs

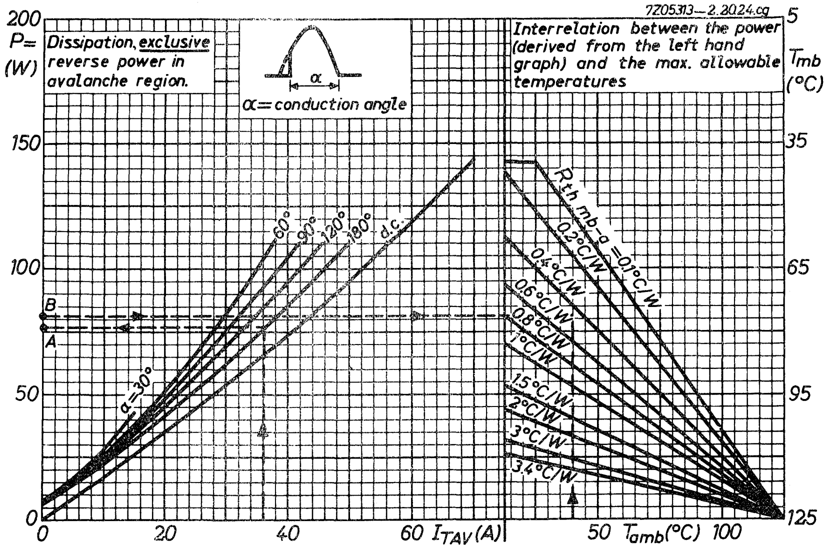
Turn-off time when switched from
I_T = 50 A to $V_R \geq$ 50 V with

	T_j = 125 °C t_q	<	250 µs
$-dI/dt$ = 50 A/µs; dV_D/dt = 10 V/µs	T_j = 25 °C t_q	<	100 µs

OPERATING NOTES

See general pages at the beginning of this section.





Determination of the heatsink thermal resistance

Example:
Assume a thyristor, used in a single phase full wave rectifier circuit.

frequency	f	=	50	Hz
conduction angle	α	=	180°	
average forward current	I_{TAV}	=	36	A (per thyristor)
ambient temperature	T_{amb}	=	40	$^{\circ}$C
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	=	8	kW (per thyristor)
duration of P_{RRM}	t	=	10	μs

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 (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: $P_{RAV} = 0.0005 \times 8$ kW = 4 W.

Therefore the total device power dissipation P_{tot} = (77 + 4) W = 81 W (point B).

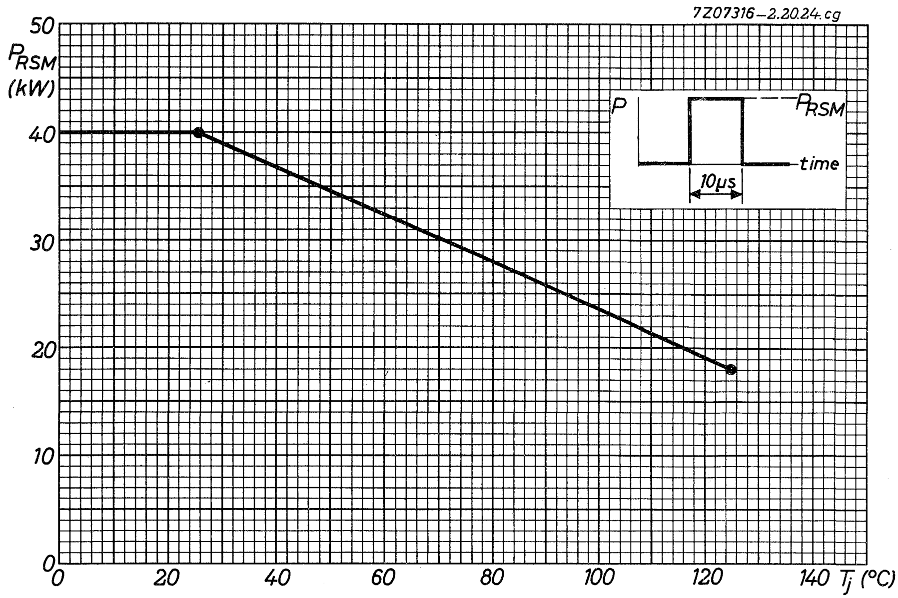
From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 81 W at T_{amb} = 40 $^{\circ}$C.

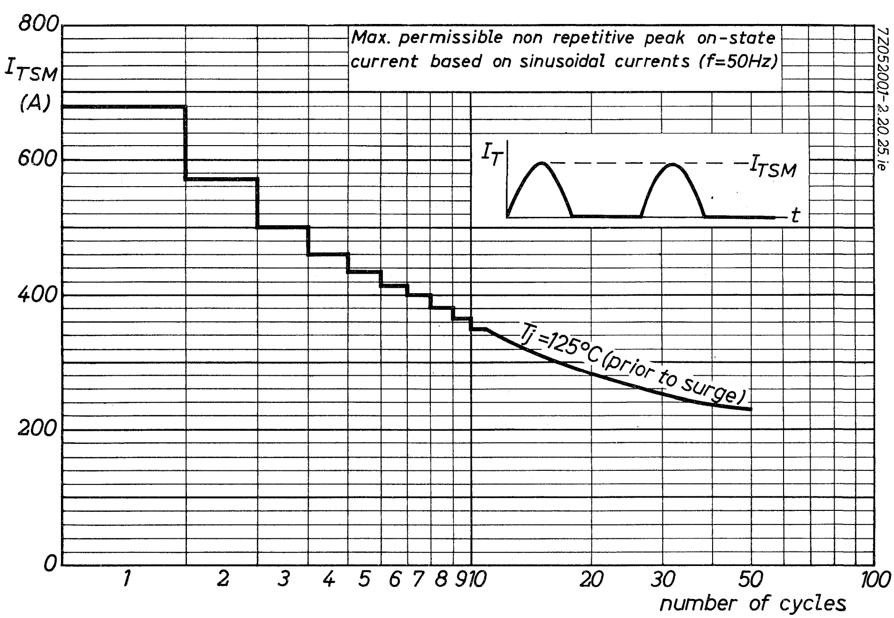
$$R_{th\ mb\text{-}a} \approx 0.47\ ^{\circ}C/W$$

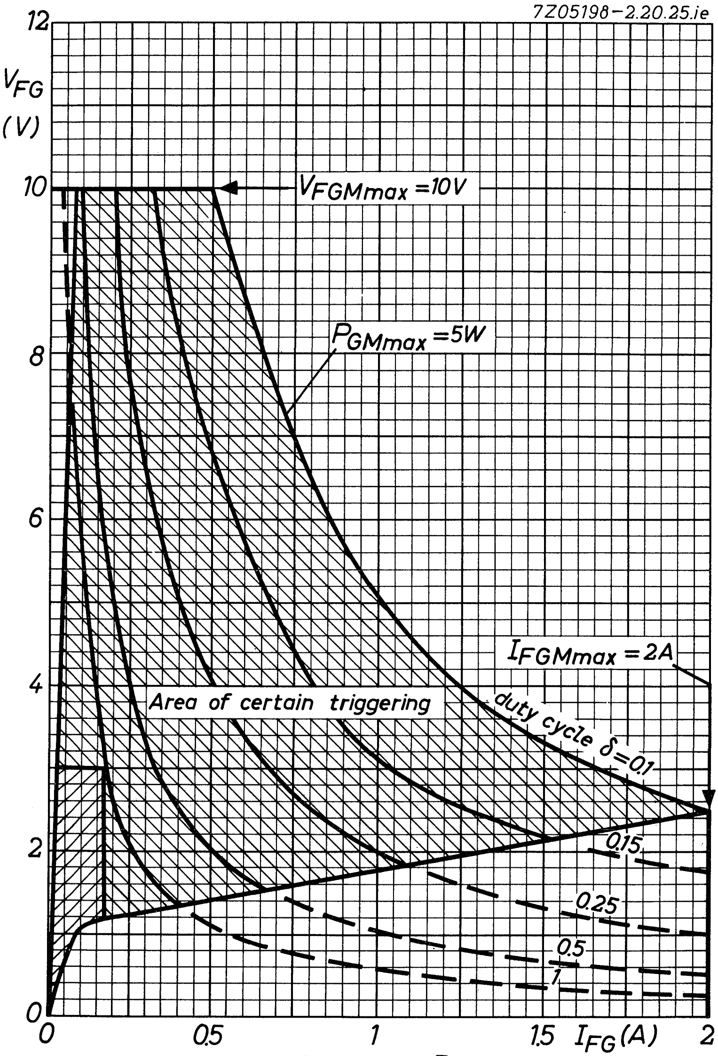
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.1 $^{\circ}$C/W.
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (0.47 - 0.1)\ ^{\circ}C/W = 0.37\ ^{\circ}C/W.$$

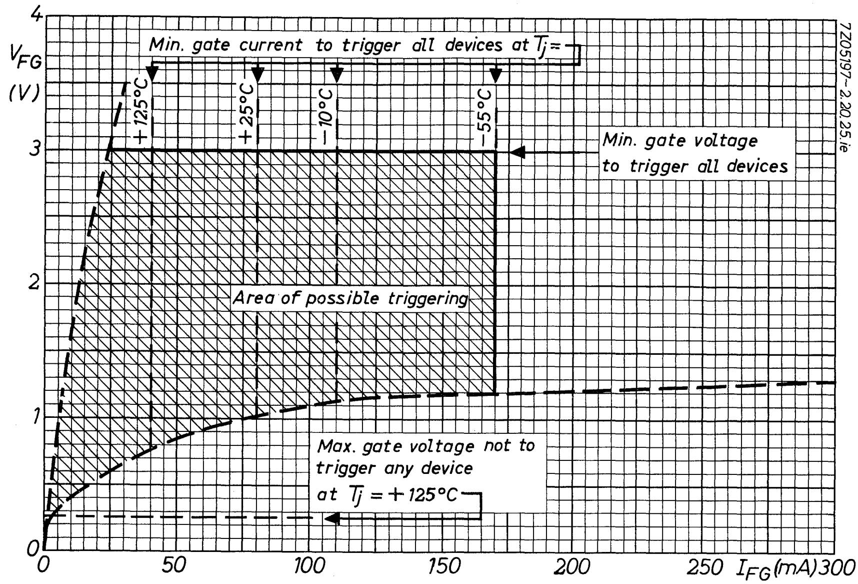
The applicable heatsink(s) may then be found in the Section HEATSINKS.

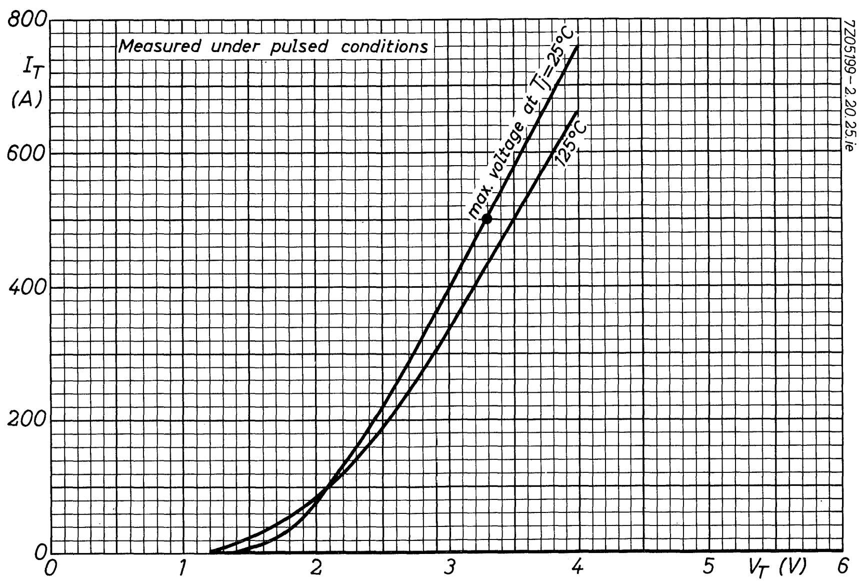

7Z07316–2.20.24.cg
50
P_{RSM}
(kW)
40
30
20
10
0
0
20
40
60
80
100
120
140 T_j (°C)
P
P_{RSM}
time
10µs

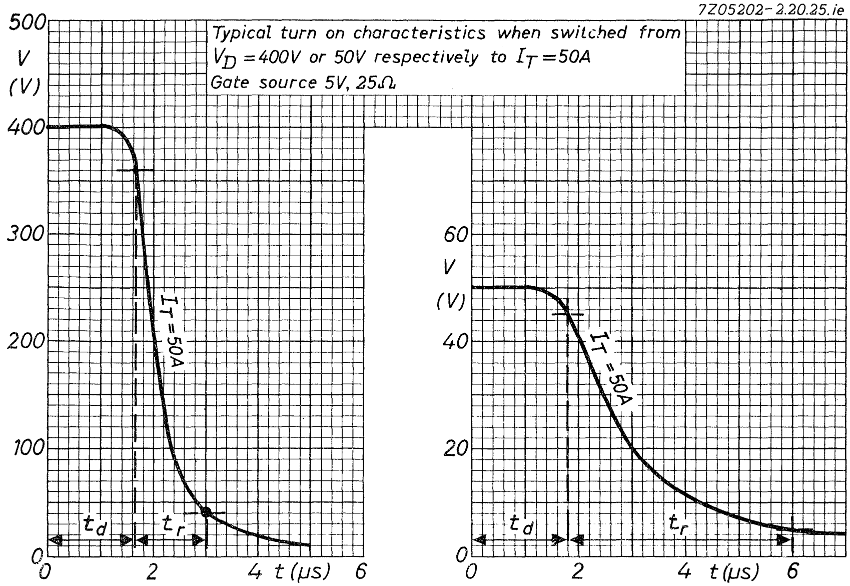

800
I_{TSM}
(A)
600
400
200
0
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f=50Hz)
7Z052001–2.20.25.ie
I_T
I_{TSM}
t
T_j =125°C (prior to surge)
1
2
3
4
5
6
7
8
9
10
20
30
50
100
number of cycles



Gate characteristics with curves P_{GAV} = 0.5 W


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
V_{FG} (V)
I_{FG} (mA)
7Z05197-2.20.25.ie
0
1
2
3
4
50
100
150
200
250
300


Measured under pulsed conditions
max. voltage at T_j=25°C
125°C
I_T (A)
V_T (V)
7Z05199-2.20.25.ie
0
200
400
600
800
1
2
3
4
5
6


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

CONTROLLED AVALANCHE THYRISTORS

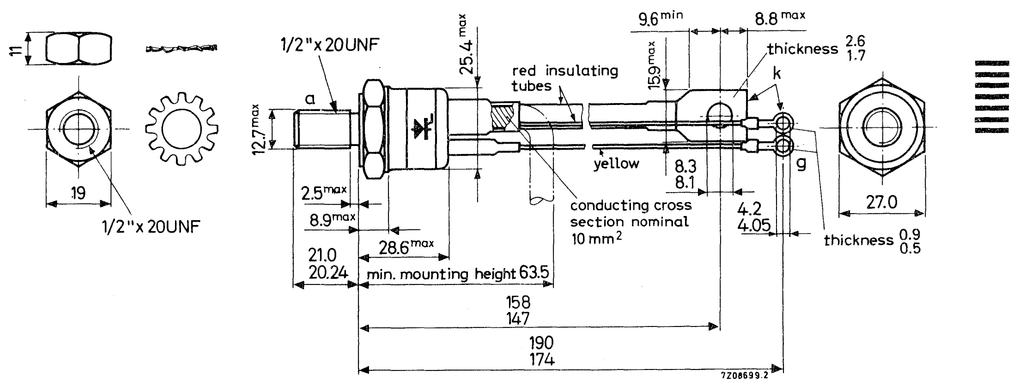
P-gate silicon thyristors in a metal envelope with ceramic insulation. They are capable of absorbing transients and intended for power control and power switching applications. The series consists of the reverse polarity types (anode to stud) BTX38-500R to BTX38-800R.

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

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 [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
R.M.S. forward current	$I_{T(RMS)}$	max.	110	A
Repetitive peak forward current	I_{TRM}	max.	1000	A
Non repetitive peak forward current t = 10 ms (See also page 7)	I_{TSM}	max.	900	A
I squared t for fusing (t = 1.5 to 10 ms)	I^2t	max.	4000	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/μs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	30	A

Power dissipation				
Non repetitive peak reverse dissipation (See also page 7) t = 10 μs; T_j = 25 °C	P_{RSM}	max.	40	kW
t = 10 μs; T_j = 125 °C	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
To ensure thermal stability: $R_{th\ j\text{-}a} \leq$ 1.5 °C/W (d.c.) or $\leq$ 3 °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.

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	$R_{th\ j\text{-}mb}$	=	0.4	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.02	$^oC/W$

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.

SWITCHING CHARACTERISTICS (See also page 10)

Turn-on time when switched from
V_D = 400 V to I_T = 50 A

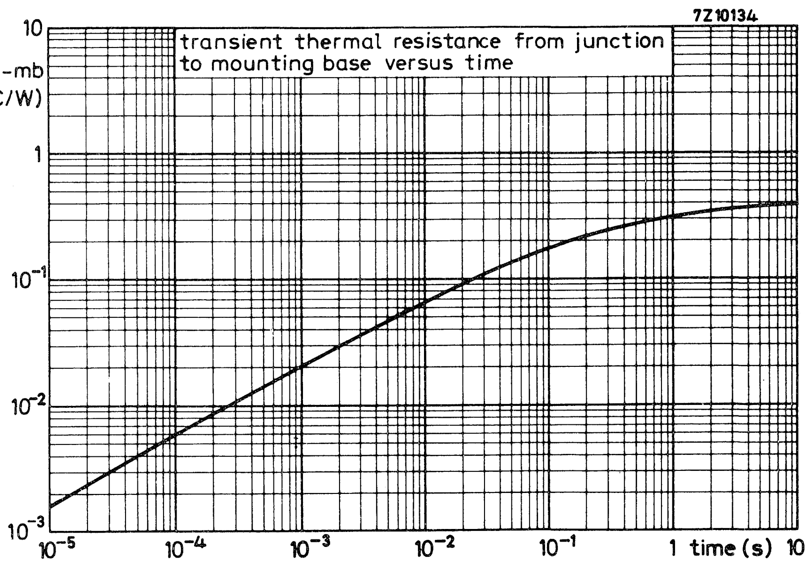
Gate source 5 V, 25 Ω, T_j = 125 °C		t_{on}	typ. 3.0	μs

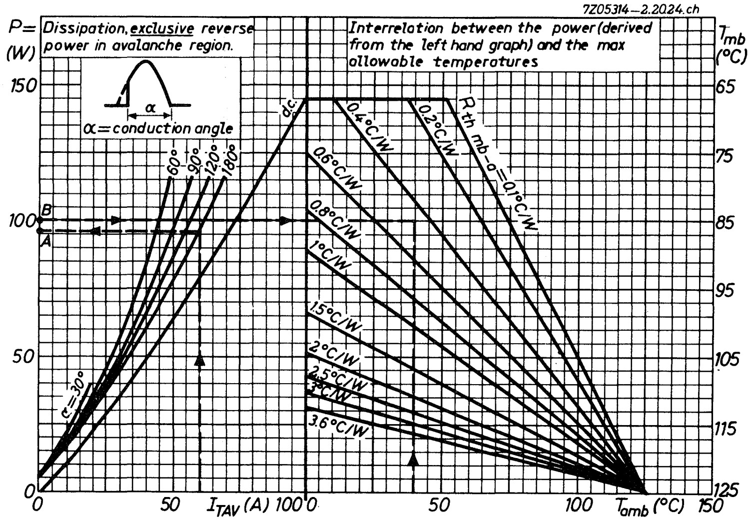
Turn-off time when switched from
I_T = 50 A to $V_R \geq$ 50 V with

$-dI/dt$ = 50 A/μs; dV_D/dt = 10 V/μs	T_j = 125 °C	t_q	<	250	μs
	T_j = 25 °C	t_q	<	100	μs

OPERATING NOTES

See general pages at the beginning of this section.





Determination of the heatsink thermal resistance

Example:
Assume a thyristor, used in a single phase full wave rectifier circuit

frequency	f	=	50	Hz
conduction angle	α	=	180°	
average forward current	I_{TAV}	=	60	A (per thyristor)
ambient temperature	T_{amb}	=	40	$^{\circ}$C
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	=	8	kW (per thyristor)
duration of P_{RRM}	t	=	10	μs

From the left hand part of the graph above it follows that at $I_{TAV} = 60$ A and $\alpha = 180^{\circ}$ 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: $P_{RAV} = 0.0005 \times 8\ kW = 4\ W$.

Therefore the total device power dissipation $P_{tot} = (96 + 4)\ W = 100\ W$ (point B).

From the right hand part of the graph above follows the thermal resistance, required for $P_{tot} = 100$ W at $T_{amb} = 40\ ^{\circ}C$.

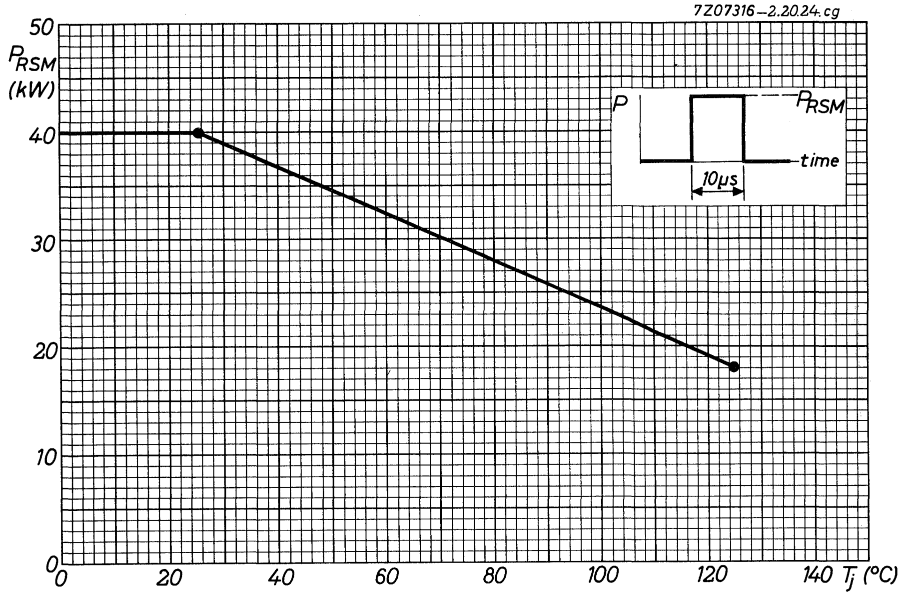
$$R_{th\ mb\text{-}a} \approx 0.45\ ^{\circ}C/W.$$

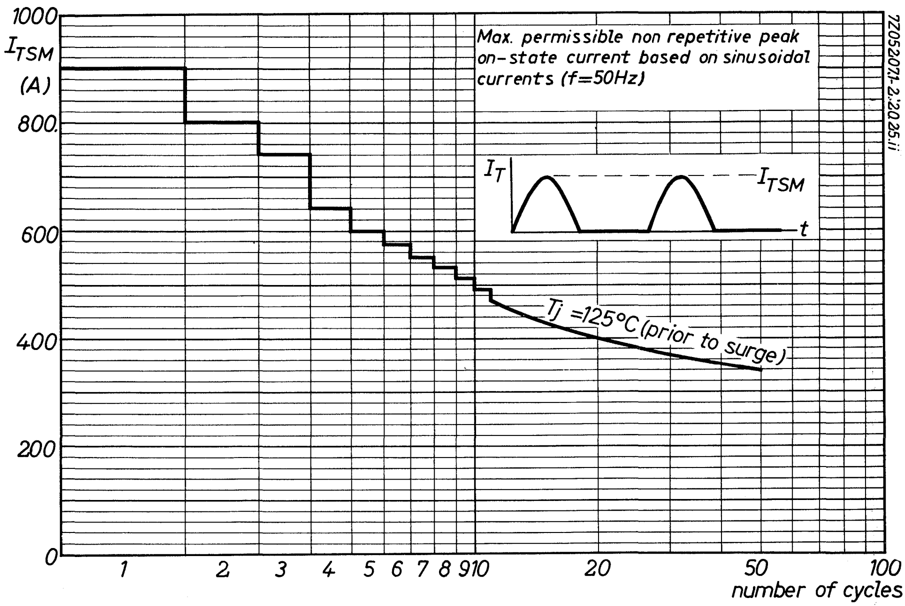
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.1\ ^{\circ}C/W$.

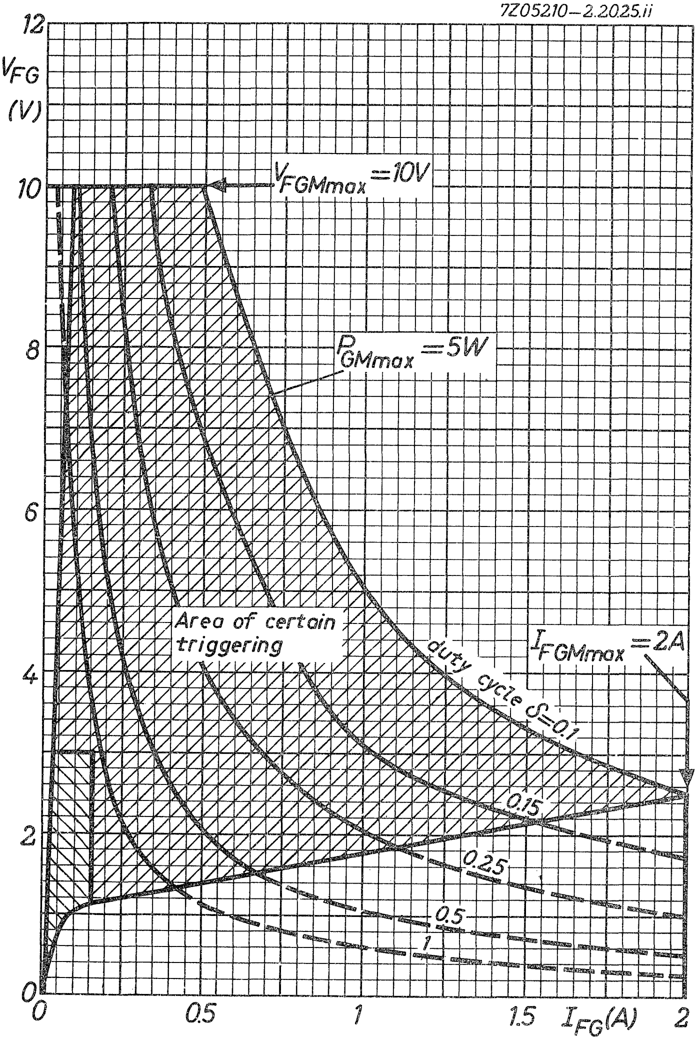
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (0.45 - 0.1)\ ^{\circ}C/W = 0.35\ ^{\circ}C/W.$$

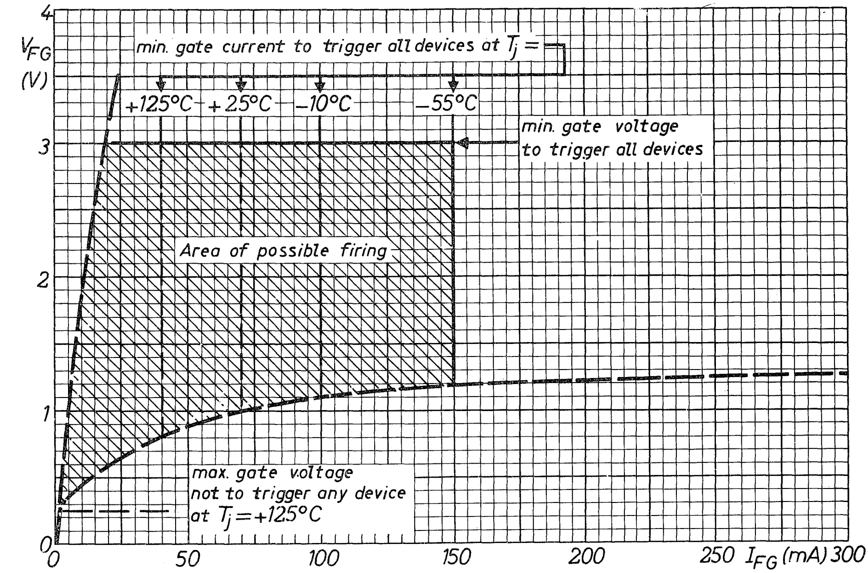
The applicable heatsink(s) may then be found in the Section HEATSINKS.

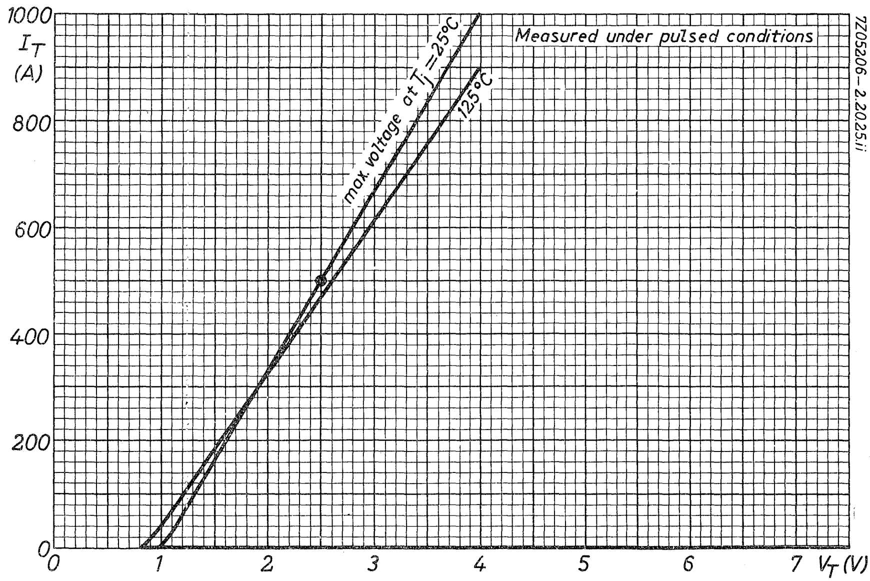

7Z07316–2.20.24.cg
50
P_{RSM}
(kW)
40
30
20
10
0
0
20
40
60
80
100
120
140 T_j (°C)
P
P_{RSM}
time
10μs

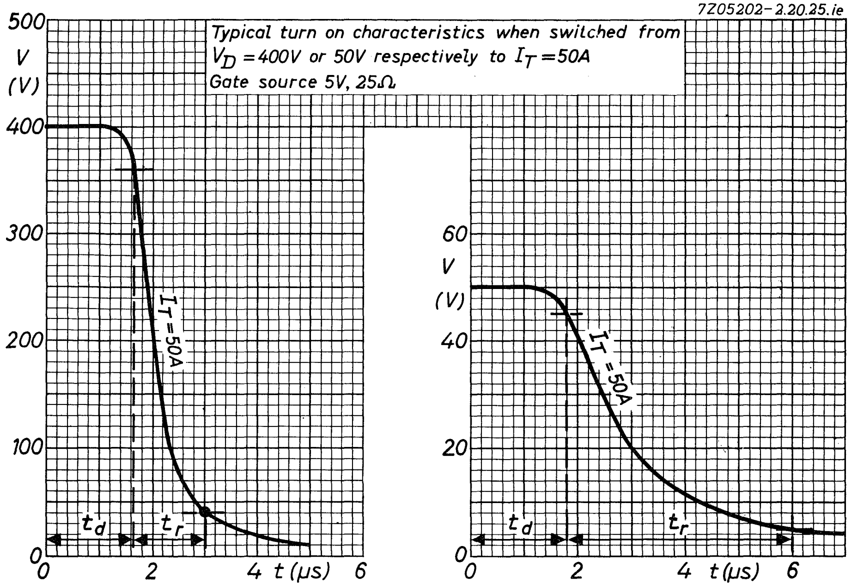

1000
I_{TSM}
(A)
800
600
400
200
0
1
2
3
4
5
6
7
8
9
10
20
50
100
number of cycles
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f=50Hz)
I_T
I_{TSM}
t
T_j =125°C (prior to surge)
7Z05207.1-2.20.25.ii



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 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
max. voltage at T_j = 25°C
125°C
7Z05206-2.2025.ii
V_T (V)
0
1
2
3
4
5
6
7
200
400
600
800
1000


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

SILICON THYRISTORS

P-gate silicon thyristors in a metal envelope with ceramic insulation. They are intended for power control and power switching applications. The series consists of 5 reverse polarity types (anode to stud) BTX41-800R to BTX41-1600R. Together with the watercooled heatsink 56311 they are specially suited for welding.

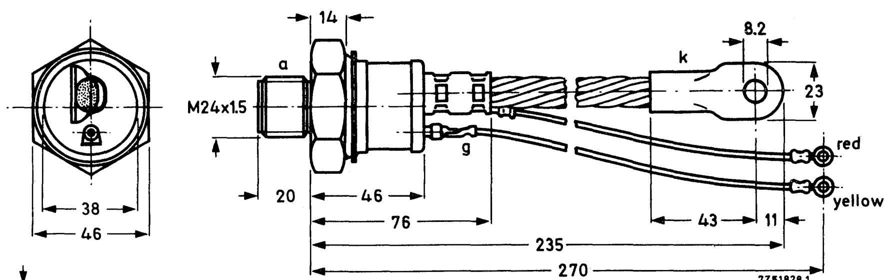
QUICK REFERENCE DATA

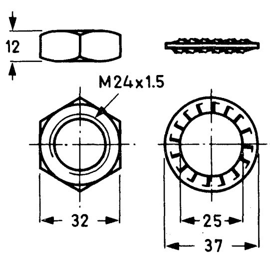
	BTX41 -	800R	1000R	1200R	1400R	1600R	
$V_{DWM} = V_{RWM}$	max.	800	1000	1200	1400	1600	V
$V_{DRM} = V_{RRM}$	max.	800	1000	1200	1400	1600	V

Average on-state current up to T_{mb} = 65 °C	I_{TAV}	max.	250	A
at T_{mb} = 85 °C	I_{TAV}	max.	160	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	400	A
Non repetitive peak on-state current; t = 10 ms	I_{TSM}	max.	5500	A
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	30	A/µs
Rate of rise of off-state voltage that will not trigger any device exponential up to $\frac{2}{3}V_{DRMmax}$	$\frac{dV_D}{dt}$	<	20	V/µs
On request	$\frac{dV_D}{dt}$	up to	200	V/µs

MECHANICAL DATA

Dimensions in mm





Net weight: 530 g

Torque on nut: min. 300 kg cm
(30 Newton metres)
max. 400 kg cm
(40 Newton metres)

Diameter of clearance hole: max. 25 mm

Heatsinks available: 56284
56311 (for welding)

All information applies to frequencies up to 400 Hz.

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

ANODE TO CATHODE

Voltages 1)		BTX41-800R	1000R	1200R	1400R	1600R	
Continuous voltages $V_D = V_R$	max.	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	800	1000	1200	1400	1600	V
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	800	1000	1200	1400	1600	V
Non repetitive peak voltages ($t \leq 10$ ms) $V_{DSM} = V_{RSM}$	max.	900	1200	1400	1600	1800	V

Currents 2)

Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 65\,^{o}C$	I_{TAV}	max.	250	A
at $T_{mb} = 85\,^{o}C$	I_{TAV}	max.	160	A
On-state current (d.c.)	I_T	max.	400	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	400	A
Repetitive peak on-state current	I_{TRM}	max.	2500	A
Non repetitive peak on-state current ($t = 10$ ms; half sine wave) $T_j = 110\,^{o}C$ prior to surge	I_{TSM}	max.	5500	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	150000	A^2s
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	30	A/μs

GATE TO CATHODE

Forward peak voltage	V_{FGM}	max.	6	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	3	A

Power dissipation

Average power dissipation	P_{GAV}	max.	2	W
Peak power dissipation	P_{GM}	max.	10	W

TEMPERATURES

Storage temperature	T_{stg}		−40 to +125	^{o}C
Operating junction temperature	T_j	max.	110	^{o}C

1) These ratings apply to a gate voltage range of V_{RGMmax} to V_{GDmax}.
2) The temperature of the cathode cable lug should be kept below 105 ^{o}C.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	0.12	$^oC/W$
From mounting base to heatsink with heatsink compound, e.g. Dow Corning 340	$R_{th\ mb-h}$	=	0.03	$^oC/W$
Transient thermal impedance from junction to mounting base (t = 10 ms)	$Z_{th\ j-mb}$	=	0.015	$^oC/W$

CHARACTERISTICS

$T_j = 110\ ^oC$ unless otherwise specified

ANODE TO CATHODE

Voltages

		BTX41 - 800R	1000R	1200R	1400R	1600R	
On-state voltage at $I_T = 600$ A	V_T	< 1.5	1.5	1.5	1.6	1.6	V

Rate of rise of off-state voltage that will not trigger any device

exponential up to $\frac{2}{3}V_{DRMmax}$	$\frac{dV_D}{dt}$	<	20	V/μs
On request	$\frac{dV_D}{dt}$	up to 200		V/μs

Currents

Peak reverse current $V_R = V_{RWMmax}$	I_{RM}	<	10	mA
Peak off-state current $V_D = V_{DWMmax}$	I_{DM}	<	10	mA
Holding current at $T_j = 25\ ^oC$	I_H	<	150	mA

GATE TO CATHODE

Voltages

Gate trigger voltage

$V_D = 6$ V; $T_j = 25\ ^oC$	V_{GT}	>	2.5	V

Gate non-trigger voltage

$V_D = V_{DRMmax}$	V_{GD}	<	0.15	V

Currents

Gate trigger current

$V_D = 6$ V; $T_j = 25\ ^oC$	I_{GT}	>	250	mA
$V_D = 6$ V; $T_j = -40\ ^oC$	I_{GT}	>	300	mA

SWITCHING CHARACTERISTICS

Turn on time when switched from

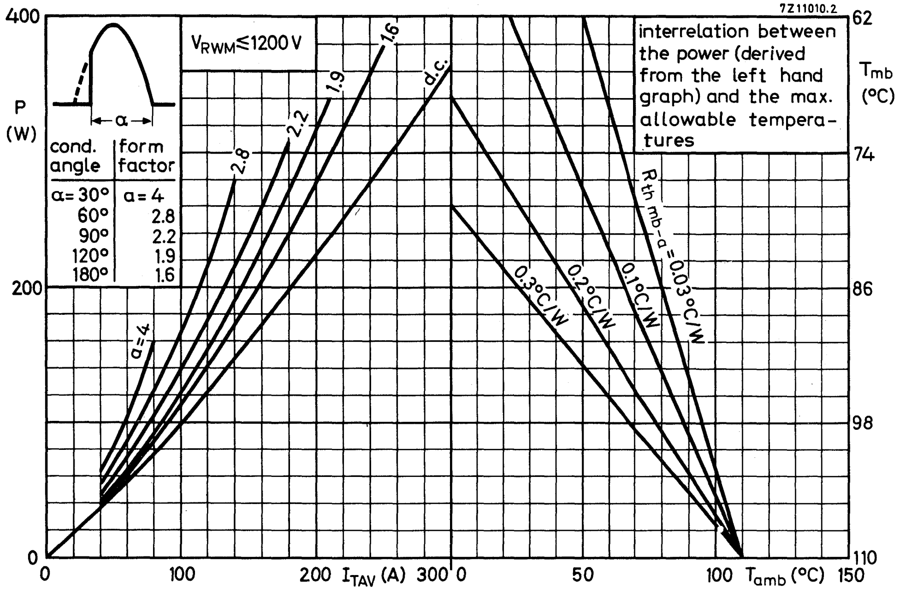
V_D = 100 V to I_T = 250 A; I_G = 1.5 A;

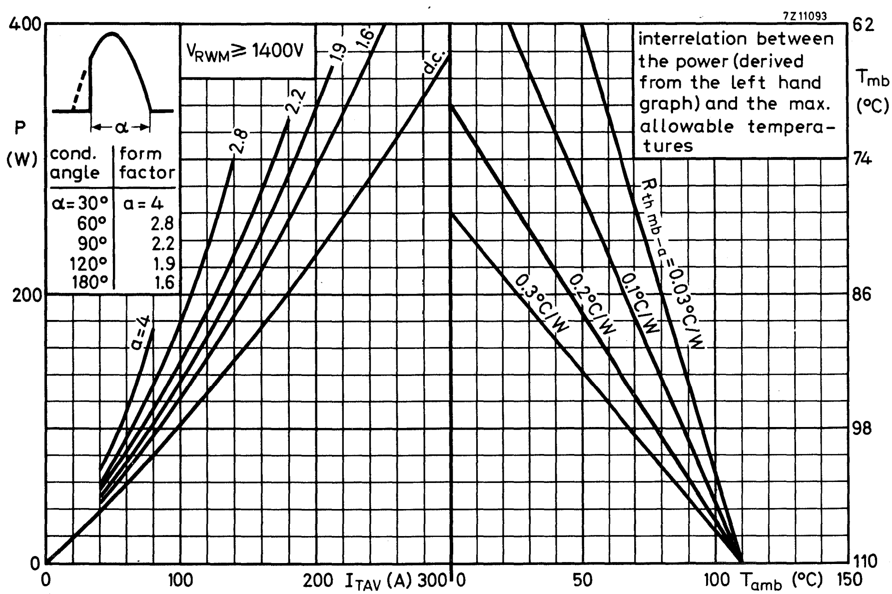
$\frac{dI_G}{dt}$ = 3 A/μs; T_j = 25 °C | t_{on} | < | 20 | μs

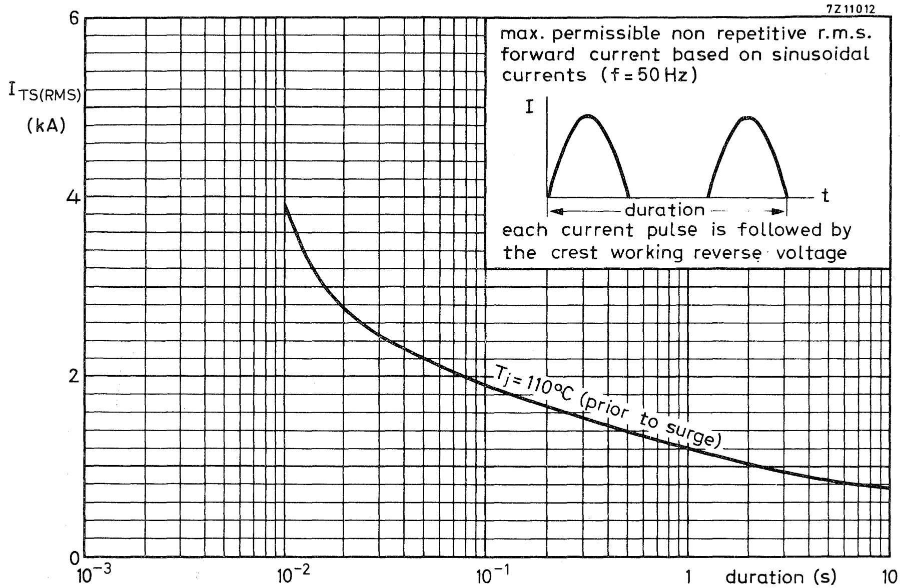
Turn off time when switched from

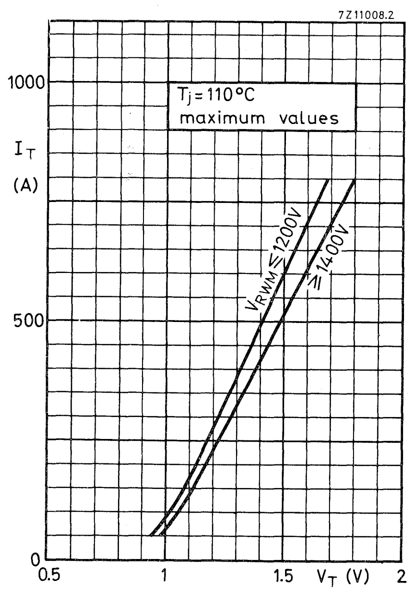
I_T = 50 A to I_R = 25 A

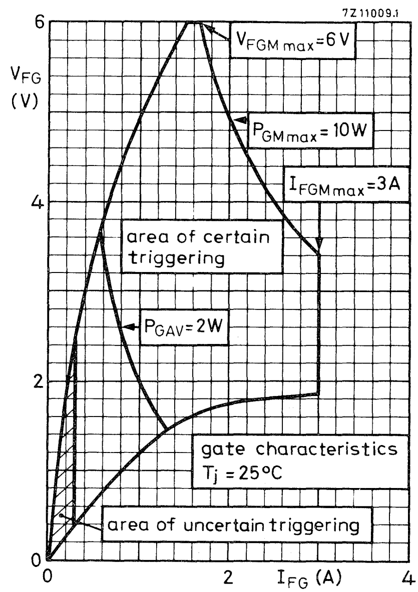
$\frac{dV_D}{dt}$ = 20 V/μs; $-\frac{dI_T}{dt}$ = 20 A/μs; T_j = 110 °C | t_{off} | typ. | 200 | μs


7Z11010.2
400
200
0
P
(W)
cond. angle
form factor
α = 30°
a = 4
60°
2.8
90°
2.2
120°
1.9
180°
1.6
α
$V_{RWM} \leq 1200$ V
2.8
2.2
1.9
1.6
d.c.
a = 4
0
100
200
I_{TAV} (A)
300
0
50
100
T_{amb} (°C)
150
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
$R_{th\ mb-a}$ = 0.03°C/W
0.1°C/W
0.2°C/W
0.3°C/W
62
74
86
98
110
T_{mb}
(°C)

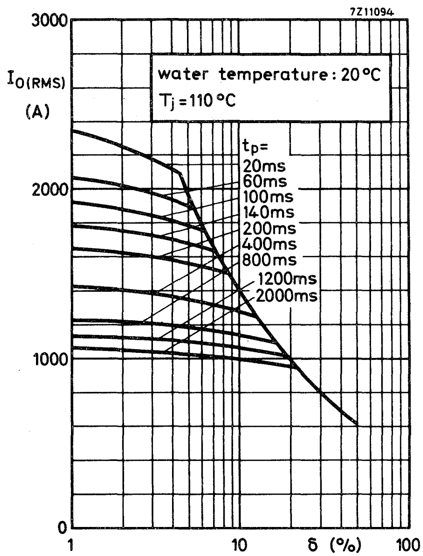

7Z11093
400
200
0
P
(W)
cond. angle
form factor
α = 30°
a = 4
60°
2.8
90°
2.2
120°
1.9
180°
1.6
α
$V_{RWM} \geq 1400$ V
2.8
2.2
1.9
1.6
d.c.
a = 4
0
100
200
I_{TAV} (A)
300
0
50
100
T_{amb} (°C)
150
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
$R_{th\ mb-a}$ = 0.03°C/W
0.1°C/W
0.2°C/W
0.3°C/W
62
74
86
98
110
T_{mb}
(°C)

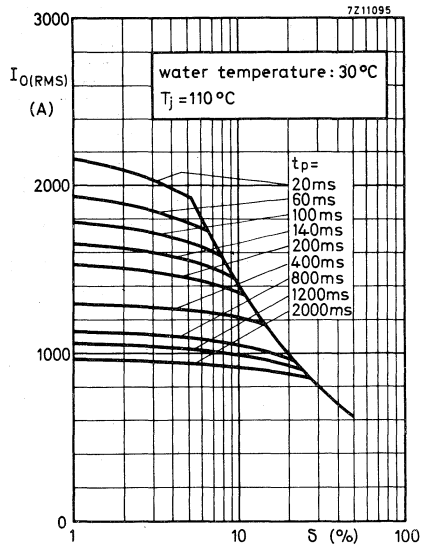

7Z11012
max. permissible non repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I
t
duration
each current pulse is followed by the crest working reverse voltage
I_TS(RMS) (kA)
6
4
2
0
10^-3
10^-2
10^-1
1
duration (s)
10
Tj = 110 °C (prior to surge)

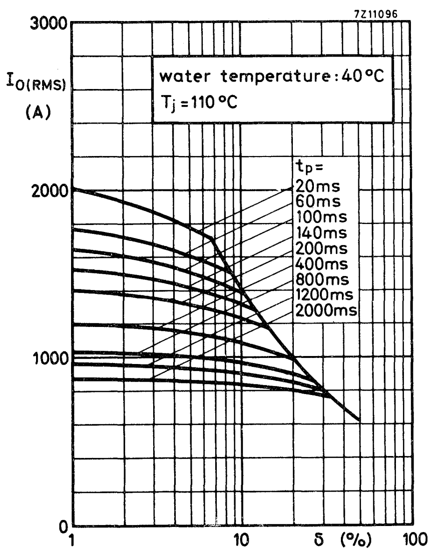

7Z11008.2
Tj = 110 °C
maximum values
I_T (A)
1000
500
0
0.5
1
1.5
V_T (V)
2
V_RWM ≤ 1200V
≥ 1400V

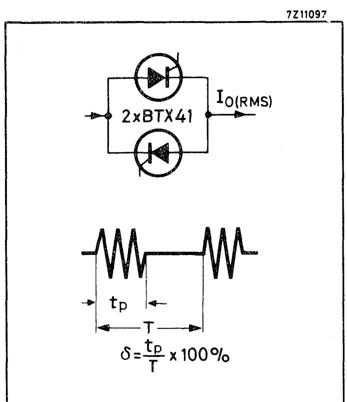

7Z11009.1
V_FG (V)
6
4
2
0
V_FGM max = 6 V
P_GM max = 10 W
I_FGM max = 3 A
area of certain triggering
P_GAV = 2 W
gate characteristics
Tj = 25 °C
area of uncertain triggering
2
I_FG (A)
4

Intermittent overload capability of 2 BTX41 thyristors in antiparallel connection in a single phase a.c. control circuit (e.g. welding).

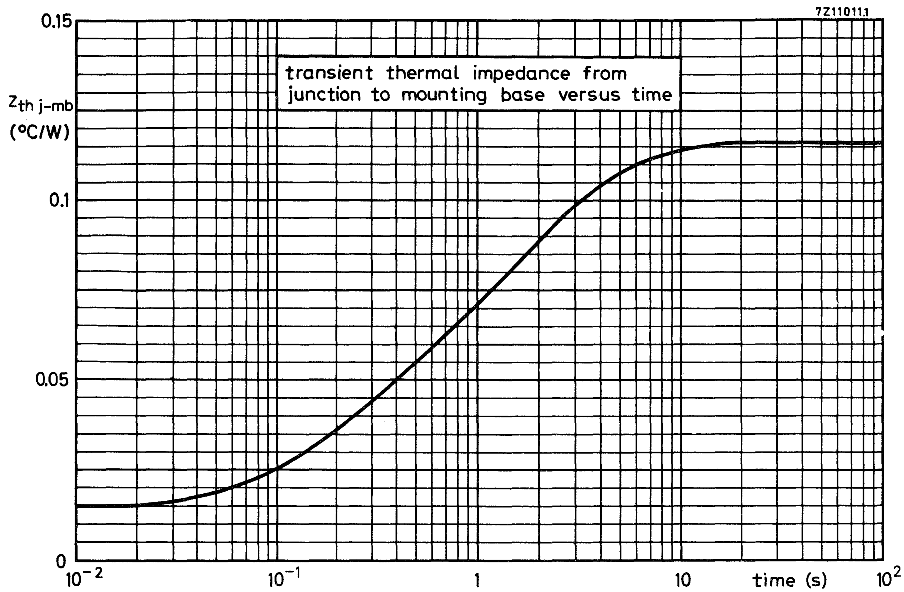








Notes:
conduction angle: 360°
heatsink : 56311
water flow : 4 ℓ/min


7Z11011.1
0.15
$Z_{th\ j-mb}$
(°C/W)
0.1
0.05
0
transient thermal impedance from junction to mounting base versus time
10^{-2}
10^{-1}
1
10
time (s)
10^{2}

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 (d.c. motor speed control, furnaces and lighting). The series consists of the following reverse polarity types (stud anode): BTX47-1000R; BTX47-1200R and BTX47-1400R.

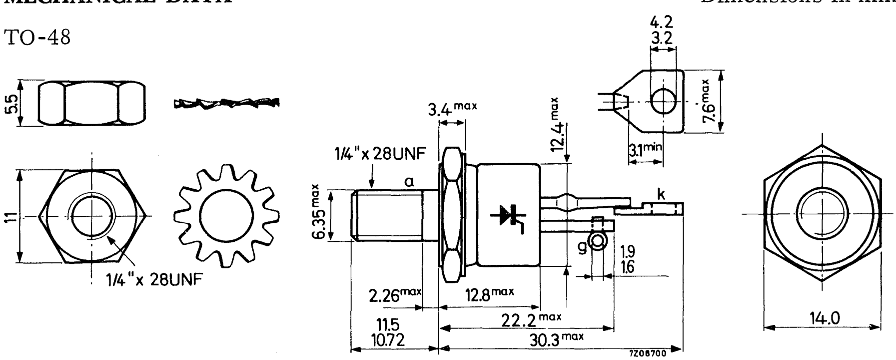
QUICK REFERENCE DATA

			BTX47-1000R	1200R	1400R	
Crest working reverse voltage	V_{RWM}	max.	800	800	800	V
Crest working off-state voltage	V_{DWM}	max.	800	800	800	V
Reverse breakdown voltage in the avalanche region	$V_{(BR)R}$	>	1000	1200	1400	V
Forward breakover voltage	$V_{(BO)}$	>	900	1100	1300	V
Average forward current at T_{mb} = 67 °C	I_{TAV}	max.	16			A
T_{mb} = 85 °C	I_{TAV}	max.	12			A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	155			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

MECHANICAL DATA

Dimensions in mm

TO-48



Net weight : 10 g
With accessories: 15 g
Diameter of hole in heatsink: max. 6.5 mm
Accessories available: 56264A

Torque on nut: min. 17 cm kg
max. 35 cm kg

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]			BTX47-1000R	1200R	1400R	
Continuous reverse voltage	V_R	max.	800	800	800	V
Crest working reverse voltage	V_{RWM}	max.	800	800	800	V
Repetitive peak reverse voltage (δ = 0.01; f = 50 Hz)	V_{RRM}	max.	1000	1200	1400	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	1000	1200	1400	V
Continuous off-state voltage	V_D	max.	800	800	800	V
Crest working off-state voltage	V_{DWM}	max.	800	800	800	V [3]
Repetitive peak off-state voltage (δ = 0.01; f = 50 Hz)	V_{DRM}	max.	900	1100	1300	V

Currents

Average forward current (averaged over any 20 ms period) T_{mb} = 67 °C	I_{TAV}	max.	16	A
T_{mb} = 85 °C	I_{TAV}	max.	12	A
Forward current (d.c.)	I_T	max.	20	A
R.M.S. forward current	$I_{T(RMS)}$	max.	25	A
Repetitive peak forward current	I_{TRM}	max.	160	A
Non repetitive peak forward current (t = 10 ms); see also page 9	I_{TSM}	max.	155	A
I squared t for fusing (t = 1 to 10 ms)	I^2t	max.	125	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	50	A/μs
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: $R_{th\ j-a} \leqq 3.0$ °C/W (d.c.) or $\leqq 6.0$ °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.

RATINGS (Limiting values) (continued)

ANODE TO CATHODE

Power dissipation

Non repetitive peak reverse dissipation				
$t = 10\ \mu s$; $T_j = 25\ ^oC$	P_{RSM}	max.	18	kW
$t = 10\ \mu s$; $T_j = 125\ ^oC$	P_{RSM}	max.	7.5	kW

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	$R_{th\ j\text{-}mb}$	=	1.0	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.05	$^oC/W$

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTX47-1000R	1200R	1400R	
Forward on-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	4.0	4.0	4.0	V [1]
Reverse breakdown voltage in the avalanche region	$V_{(BR)R}$	>	1000	1200	1400	V
Forward breakover voltage	$V_{(BO)}$	>	900	1100	1300	V

Currents

Reverse current $V_R = V_{RWMmax}$	I_R	<	5	mA
Off-state current $V_D = V_{DWMmax}$	I_D	<	5	mA
Latching current	I_L	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

SWITCHING CHARACTERISTICS

Turn-on time when switched from $V_D = V_{DWMmax}$ to I_T = 10 A

Gate source 5 V, 25 Ω	t_{on}	typ.	5.0	μs

Turn-off time when switched from I_T = 10A to $V_R \geq$ 50 V with

$-dI/dt$ = 10A/μs, dV_D/dt = 10V/μs	T_j = 125 °C	t_q	typ.	250 μs
	T_j = 25 °C	t_q	<	100 μs

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

OPERATING NOTES

1. When there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non repetitive peak reverse power, a damping circuit should be connected across the transformer.
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:

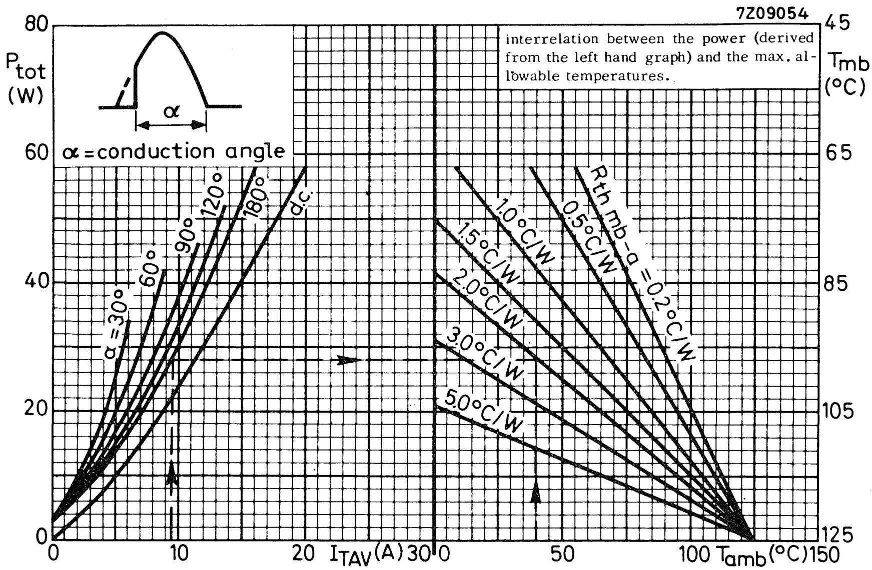
$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
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.

V_{RSM} = the transient voltage peak produced by the transformer

2. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves on page 9 a fast fuse is recommended.

3. The gate and cathode connectors should not be bent or twisted; 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.



Determination of the heatsink thermal resistance.

Example:

Assume a thyristor, used in a single phase full-wave rectifier circuit.

frequency	f	=
conduction angle	α	= 180°
average forward current	I_{TAV}	= 9.5 A (per thyristor)
ambient temperature	T_{amb}	= 40 °C

From the left hand part of the graph above it follows that at I_{TAV} = 9.5 A and α = 180° the average forward power + average leakage power = 28 W per thyristor.

From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 28 W at T_{amb} = 40 °C

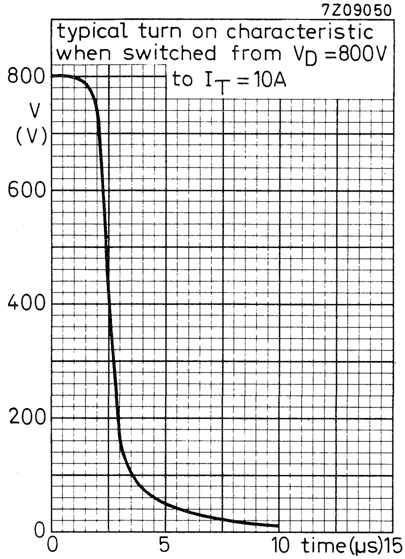
$$R_{th\ mb\text{-}a} \approx 2.0\ ^{\circ}C/W$$

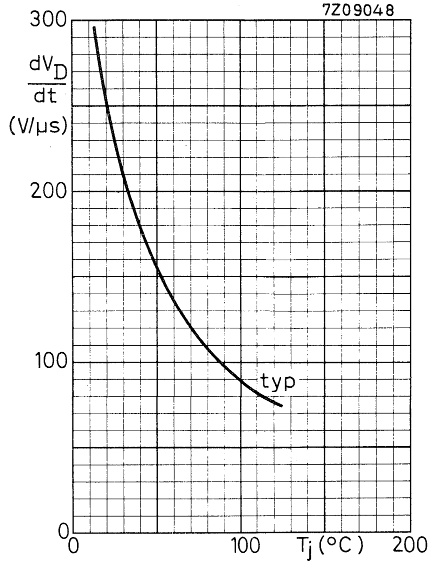
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.2 °C/W

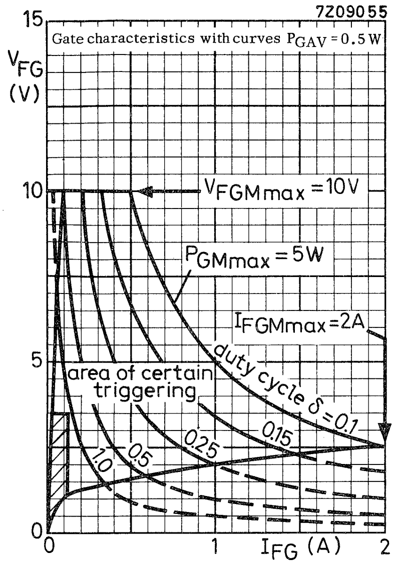
Hence the heatsink thermal resistance should be:

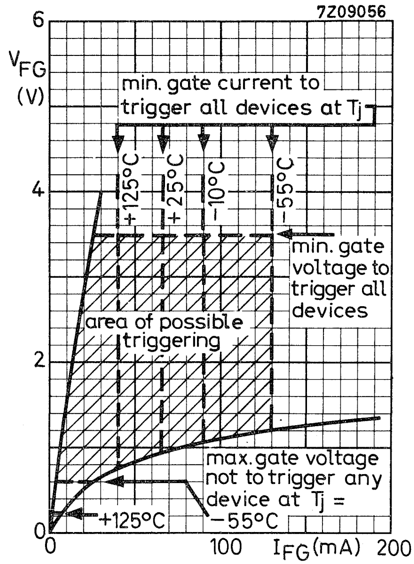
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (2.0 - 0.2)\ ^{\circ}C/W = 1.8\ ^{\circ}C/W$$

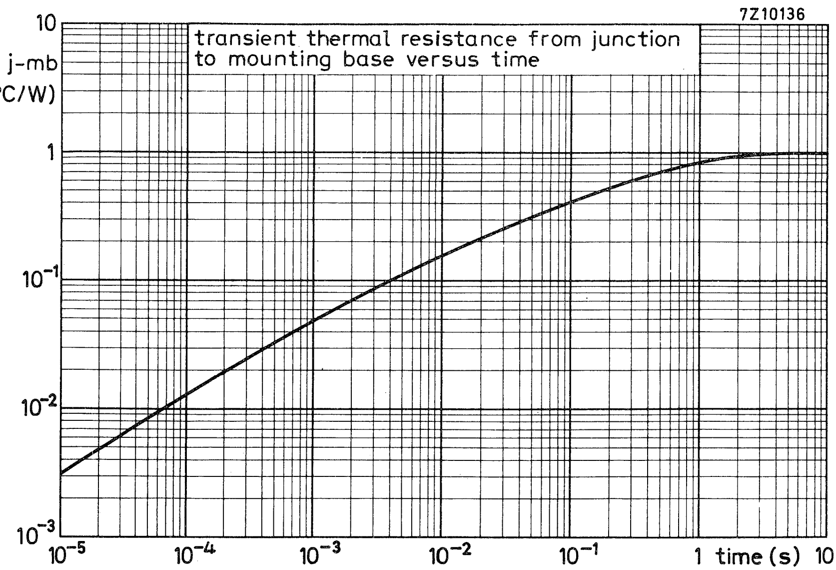
The applicable heatsink(s) may then be found in the Section HEATSINKS.

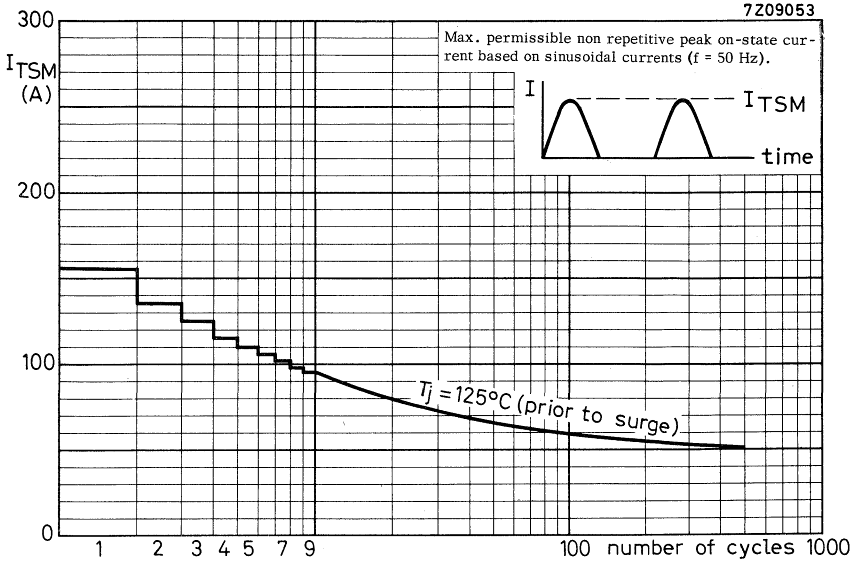

7Z09050
typical turn on characteristic
when switched from V_D =800V
to I_T =10A
800
V
(V)
600
400
200
0
0
5
10
time(μs)15

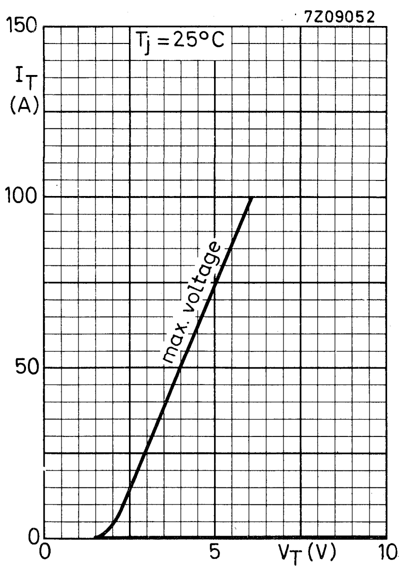

7Z09048
300
$\frac{dV_D}{dt}$
(V/μs)
200
100
0
0
100
typ
T_j (°C)
200

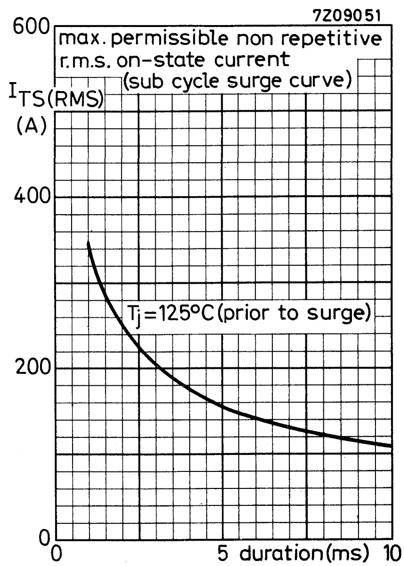

7Z09055
Gate characteristics with curves P_{GAV} = 0.5 W
V_{FG} (V)
V_{FGMmax} = 10V
P_{GMmax} = 5W
I_{FGMmax} = 2A
duty cycle δ = 0.1
0.15
0.25
0.5
1.0
area of certain triggering
I_{FG} (A)

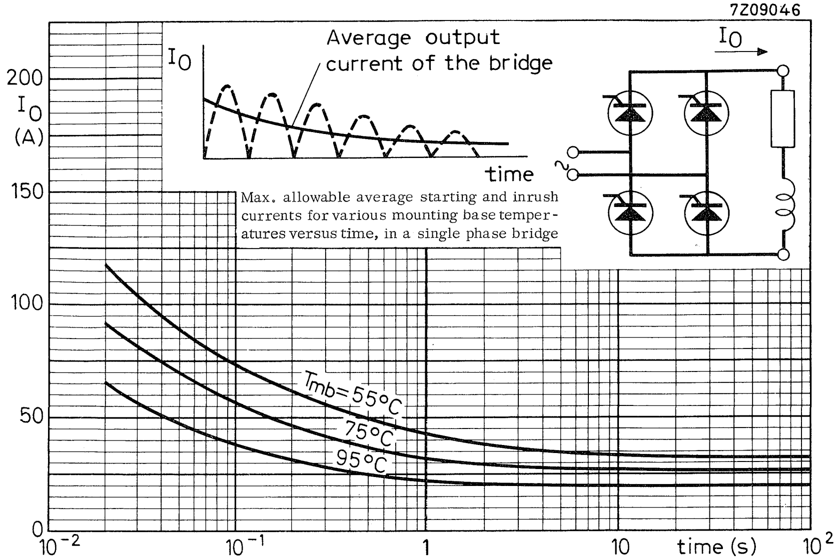

7Z09056
V_{FG} (V)
min. gate current to trigger all devices at Tj
+125°C
+25°C
−10°C
−55°C
min. gate voltage to trigger all devices
area of possible triggering
max. gate voltage not to trigger any device at Tj = −55°C
+125°C
I_{FG} (mA)

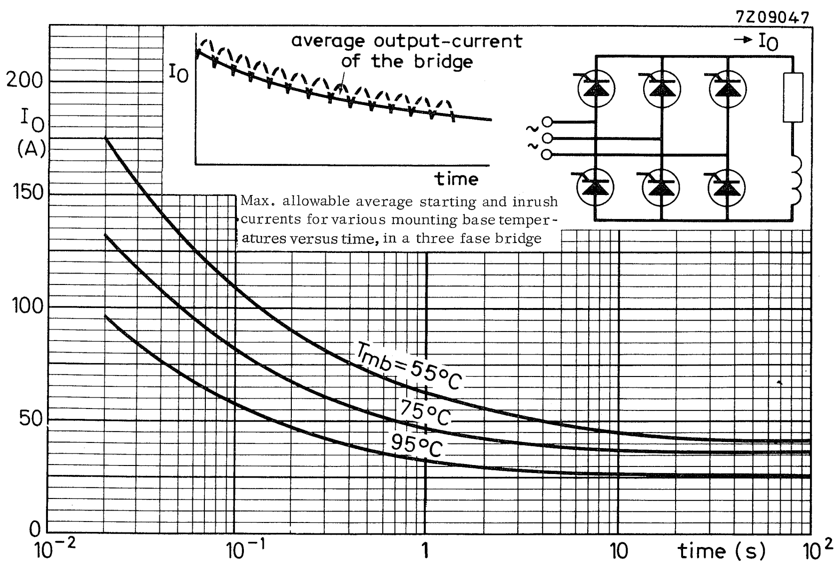

7Z10136
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$ (°C/W)
time (s)


7Z09053
300
I_{TSM}
(A)
200
100
0
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz).
I
I_{TSM}
time
T_j = 125°C (prior to surge)
1
2
3
4
5
7
9
100
number of cycles
1000


7Z09052
150
I_T
(A)
100
50
0
T_j = 25°C
max. voltage
0
5
V_T (V)
10


7Z09051
600
$I_{TS(RMS)}$
(A)
400
200
0
max. permissible non repetitive
r.m.s. on-state current
(sub cycle surge curve)
T_j=125°C (prior to surge)
0
5
duration(ms)
10


7Z09046
Average output current of the bridge
I_O
time
Max. allowable average starting and inrush currents for various mounting base temperatures versus time, in a single phase bridge
200
150
100
50
0
I_O (A)
T_{mb} = 55 °C
75 °C
95 °C
10^{-2}
10^{-1}
1
10
time (s)
10^2


7Z09047
average output-current of the bridge
I_O
time
Max. allowable average starting and inrush currents for various mounting base temperatures versus time, in a three fase bridge
200
150
100
50
0
I_O (A)
T_{mb} = 55 °C
75 °C
95 °C
10^{-2}
10^{-1}
1
10
time (s)
10^2

CONTROLLED AVALANCHE THYRISTORS

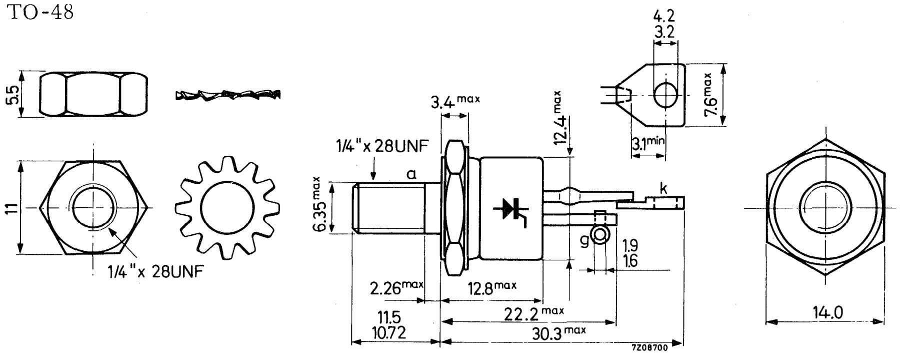
P-gate silicon thyristors in a TO-48 metal envelope, capable of absorbing transients and intended for power control and power switching applications (d.c. motor speed control, furnaces and lighting). The series consists of the following reverse polarity types (stud anode): BTX48-1000R; BTX48-1200R; BTX48-1400R;

QUICK REFERENCE DATA

			BTX48-1000R	1200R	1400R	
Crest working reverse voltage	V_{RWM}	max.	800	800	800	V
Crest working off-state voltage	V_{DWM}	max.	800	800	800	V
Reverse breakdown voltage in the avalanche region	$V_{(BR)R}$	>	1000	1200	1400	V
Forward breakover voltage	$V_{(BO)}$	>	900	1100	1300	V
Average forward current at T_{mb} = 85 °C	I_{TAV}	max.	16			A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	200			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

MECHANICAL DATA Dimensions in mm

TO-48



Net weight : 10 g
With accessories: 15 g
Diameter of hole in heatsink: max. 6.5 mm
Accessories available: 56264A

Torque on nut: min. 17 cm kg
max. 35 cm kg

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])			BTX48-1000R	1200R	1400R	
Continuous reverse voltage	V_R	max.	800	800	800	V
Crest working reverse voltage	V_{RWM}	max.	800	800	800	V
Repetitive peak reverse voltage (δ = 0.01; f = 50 Hz)	V_{RRM}	max.	1000	1200	1400	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	1000	1200	1400	V
Continuous off-state voltage	V_D	max.	800	800	800	V
Crest working off-state voltage	V_{DWM}	max.	800	800	800	V [3])
Repetitive peak off-state voltage (δ = 0.01; f = 50 Hz)	V_{DRM}	max.	900	1100	1300	V

Currents

Average forward current (averaged over any 20 ms period) T_{mb} = 85 °C	I_{TAV}	max.	16	A
Forward current (d.c.)	I_T	max.	20	A
R.M.S. forward current	$I_{T(RMS)}$	max.	25	A
Repetitive peak forward current	I_{TRM}	max.	200	A
Non repetitive peak forward current (t = 10 ms) see also page 9	I_{TSM}	max.	200	A
I squared t for fusing (t = 1 to 10 ms)	I^2t	max.	200	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	50	A/μs
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: $R_{th\ j\text{-}a} \leq 3.0$ °C/W (d.c.) or ≤ 6.0 °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.

RATINGS (Limiting values) (continued)

ANODE TO CATHODE

Power dissipation

Non repetitive peak reverse dissipation				
$t = 10\ \mu s$; $T_j = 25\ ^oC$	P_{RSM}	max.	18	kW
$t = 10\ \mu s$; $T_j = 125\ ^oC$	P_{RSM}	max.	7.5	kW

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	$R_{th\ j\text{-}mb}$	=	1.0	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.05	$^oC/W$

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

		BTX48-1000R	1200R	1400R	
Forward on-state voltage I_T = 50 A; T_j = 25 °C	V_T	< 2.7	2.7	2.7	V [1]
Reverse breakdown voltage in the avalanche region	$V_{(BR)R}$	> 1000	1200	1400	V
Forward breakover voltage	$V_{(BO)}$	> 900	1100	1300	V

Currents

Reverse current $V_R = V_{RWMmax}$	I_R	<	5	mA
Off-state current $V_D = V_{DWMmax}$	I_D	<	5	mA
Latching current	I_L	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

SWITCHING CHARACTERISTICS

Turn-on time when switched from $V_D = V_{DWMmax}$ to I_T = 10 A

Gate source 5 V, 25 Ω — t_{on} typ. 5.0 μs

Turn-off time when switched from I_T = 10A to V_R ≥ 50 V with

-dI/dt = 10A/μs, dV_D/dt = 10V/μs	T_j = 125 °C	t_q	typ.	250 μs
	T_j = 25 °C	t_q	<	100 μs

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

OPERATING NOTES

1. When there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non repetitive peak reverse power, a damping circuit should be connected across the transformer.
   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)

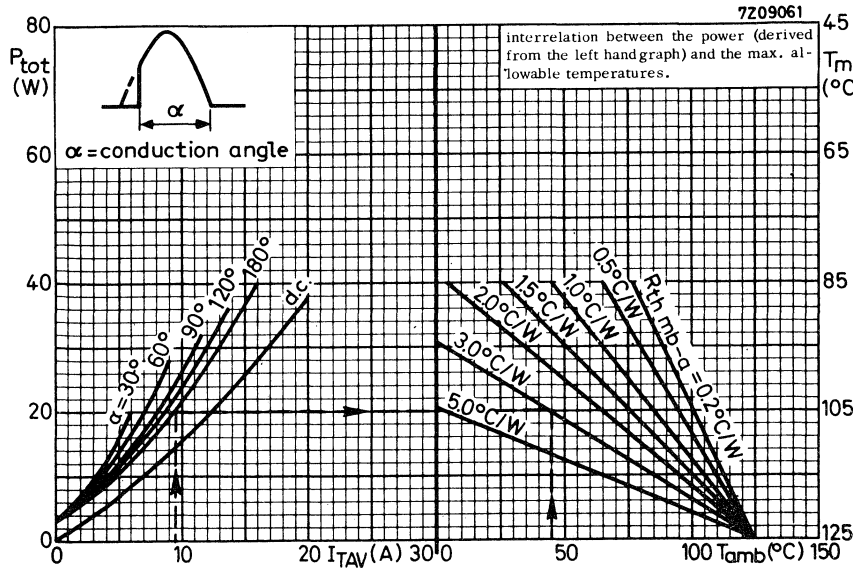
   T = V_1/V_2

   V_{RWM} stands for the actually applied crest working reverse voltage

   V_{RSM} = the transient voltage peak produced by the transformer

2. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves on page 9 a fast fuse is recommended.

3. The gate and cathode connectors should not be bent or twisted; 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.



Determination of the heatsink thermal resistance

Example:

Assume a thyristor, used in a single phase full-wave rectifier circuit.

frequency			
conduction angle	α	=	180^{o}
average forward current	I_{TAV}	=	9.5 A (per thyristor)
ambient temperature	T_{amb}	=	45 ^{o}C

From the left hand part of the graph above it follows that at $I_{TAV} = 9.5$ A and $\alpha = 180^{o}$ the average forward power + average leakage power = 20 W per thyristor.

From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 20 W at T_{amb} = 45 ^{o}C

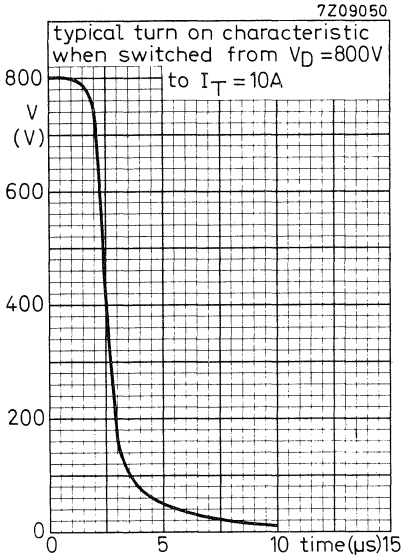
$$R_{th\ mb\text{-}a} \approx 3.0\ ^{o}C/W$$

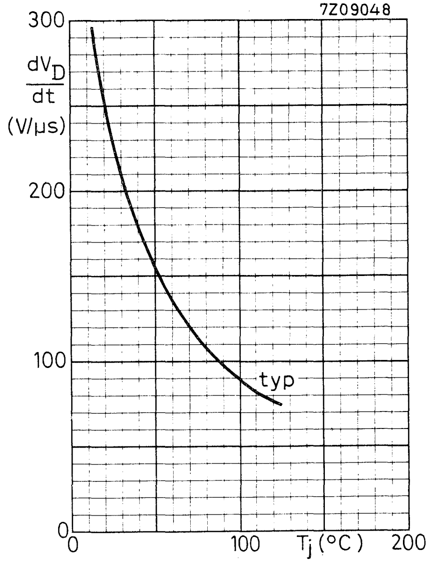
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.2\ ^{o}C/W$

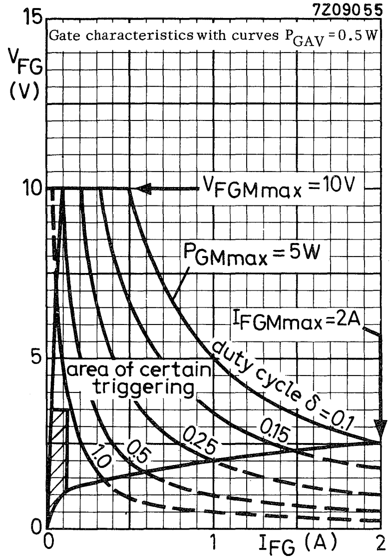
Hence the heatsink thermal resistance should be:

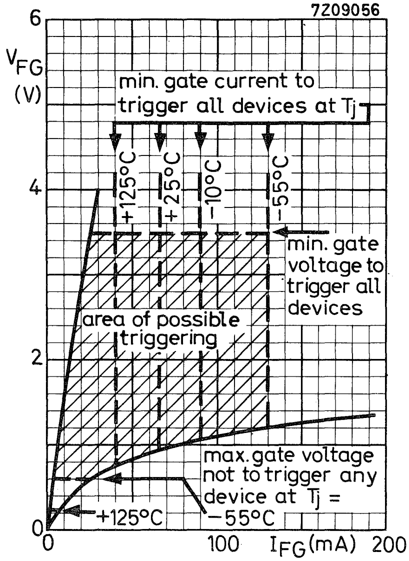
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (3.0 - 0.2)\ ^{o}C/W = 2.8\ ^{o}C/W$$

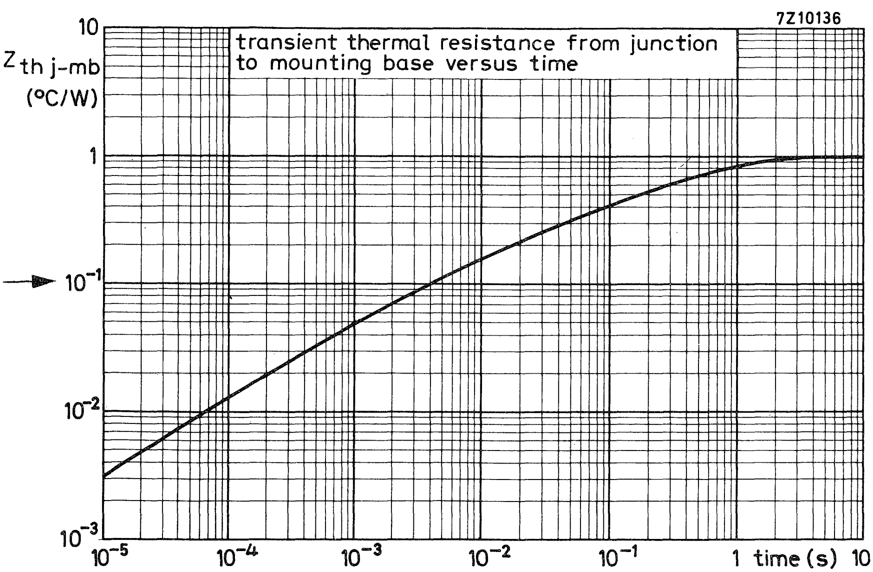
The applicable heatsink(s) may then be found in the Section HEATSINKS.

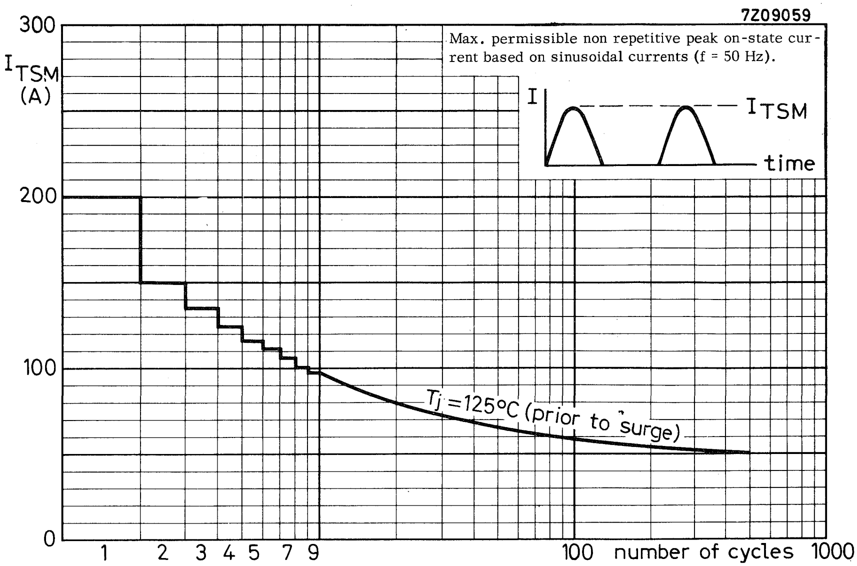

7Z09050
typical turn on characteristic
when switched from V_D =800V
to I_T =10A
800
V
(V)
600
400
200
0
0
5
10
time(μs)
15

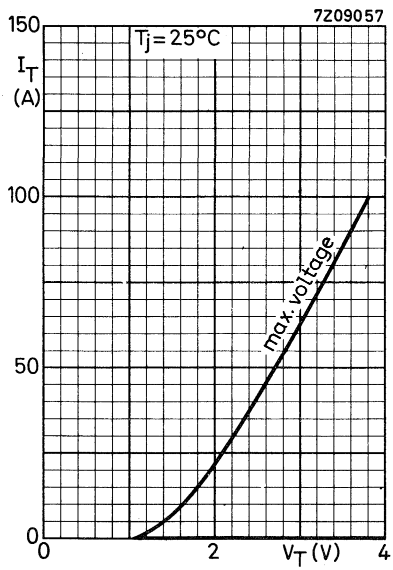

7Z09048
300
$\frac{dV_D}{dt}$
(V/μs)
200
100
typ
0
0
100
T_j (°C)
200

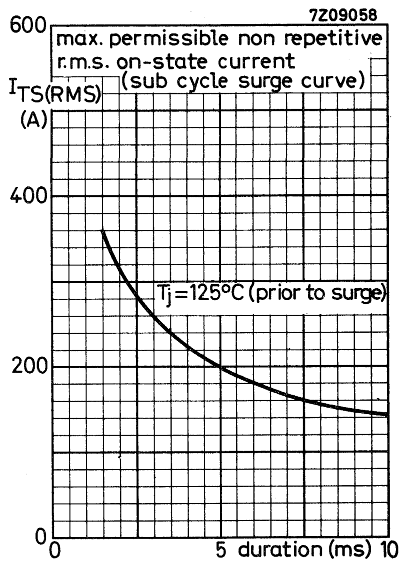

7Z09055
Gate characteristics with curves P_{GAV} = 0.5 W
V_{FG} (V)
V_{FGMmax} = 10V
P_{GMmax} = 5W
I_{FGMmax} = 2A
duty cycle δ = 0.1
0.15
0.25
0.5
1.0
area of certain triggering
I_{FG} (A)
0
1
2
5
10
15

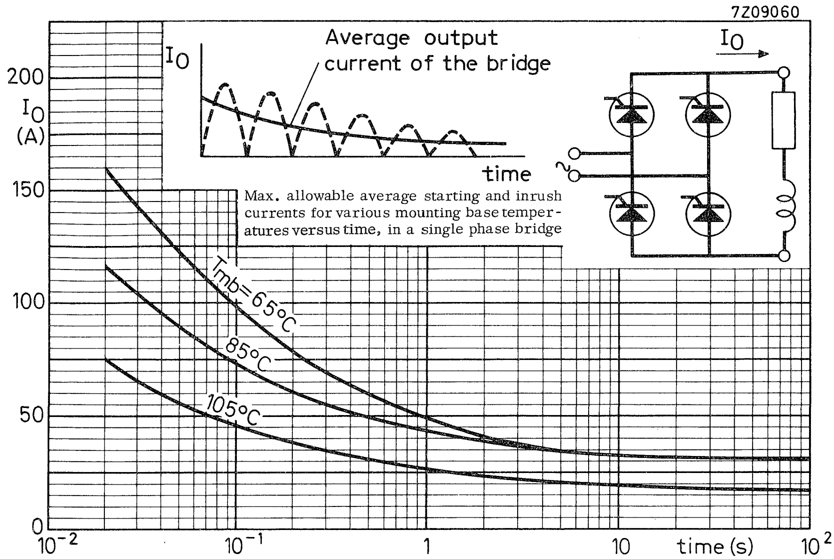

7Z09056
V_{FG} (V)
min. gate current to trigger all devices at T_j
+125°C
+25°C
−10°C
−55°C
min. gate voltage to trigger all devices
area of possible triggering
max. gate voltage not to trigger any device at T_j = −55°C
+125°C
I_{FG} (mA)
0
100
200
2
4
6

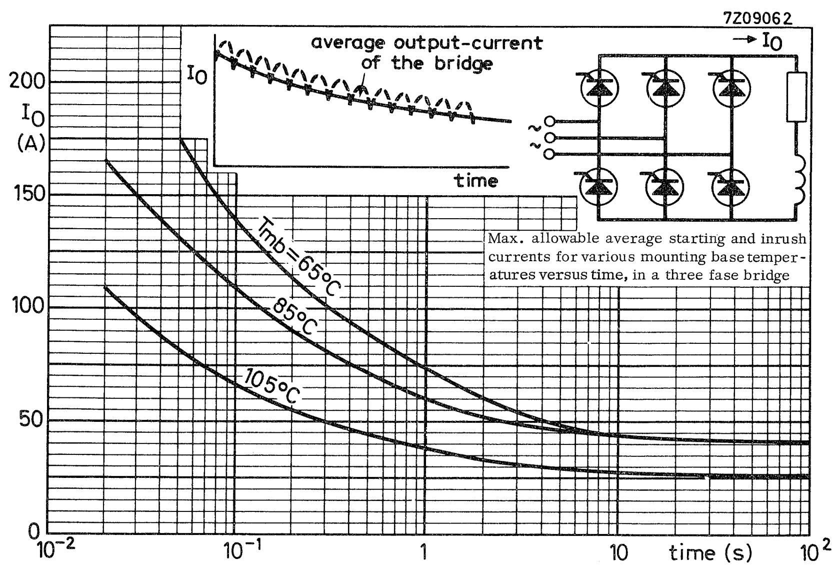

7Z10136
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10


7Z09059
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz).
I
ITSM
time
300
ITSM
(A)
200
100
0
Tj =125°C (prior to surge)
1
2
3
4
5
7
9
100
number of cycles
1000


7Z09057
Tj = 25°C
150
IT
(A)
100
50
0
max. voltage
0
2
VT (V)
4


7Z09058
max. permissible non repetitive
r.m.s. on-state current
(sub cycle surge curve)
600
ITS(RMS)
(A)
400
200
0
Tj =125°C (prior to surge)
0
5
duration (ms)
10


7Z09060
Average output
current of the bridge
IO
time
IO
Max. allowable average starting and inrush currents for various mounting base temperatures versus time, in a single phase bridge
200
IO
(A)
150
100
50
0
Tmb=65°C
85°C
105°C
10⁻²
10⁻¹
1
10
time (s)
10²


7Z09062
average output-current
of the bridge
IO
time
IO
Max. allowable average starting and inrush currents for various mounting base temperatures versus time, in a three fase bridge
200
IO
(A)
150
100
50
0
Tmb=65°C
85°C
105°C
10⁻²
10⁻¹
1
10
time (s)
10²

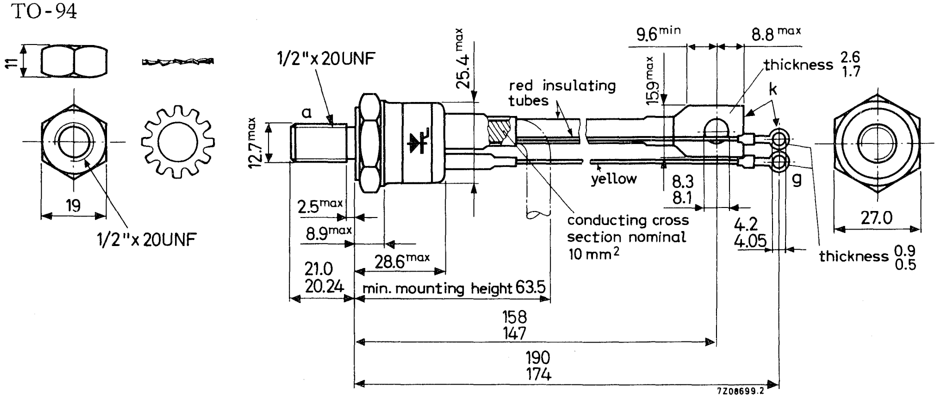
CONTROLLED AVALANCHE THYRISTORS

P-gate silicon thyristors in a TO-94 metal envelope with ceramic insulation. They are capable of absorbing transients and intended for power control and power switching applications (d.c. motor speed control, furnaces and lighting). The series consists of reverse polarity types (anode to stud): BTX49-600R to BTX49-1200R.

QUICK REFERENCE DATA							
		BTX49-600R	700R	800R	1000R	1200R	
V_{RWM}	max.	600	700	800	1000	1200	V
V_{DWM}	max.	600	700	800	1000	1200	V
$V_{(BR)R}$	>	700	800	900	1100	1300	V
$V_{(BO)}$	>	700	800	900	1100	1300	V
Average forward current at T_{mb} = 75 °C			$I_{T(AV)}$	max.		70	A
T_{mb} = 85 °C			$I_{T(AV)}$	max.		60	A
Non-repetitive peak forward current t = 10 ms			I_{TSM}	max.		1050	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

MECHANICAL DATA Dimensions in mm

TO-94



Torque on nut: min. 90 kg cm
max. 175 kg cm

Net weight: 108 g

Diameter of clearance hole: max. 13 mm

All information applies to frequencies up to 400 Hz

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

ANODE TO CATHODE

Voltages [1]

		BTX49-600R	700R	800R	1000R	1200R	
V_R	max.	600	700	800	1000	1200	V
V_{RWM}	max.	600	700	800	1000	1200	V
V_D	max.	600	700	800	1000	1200	V
V_{DWM}	max.	600	700	800	1000	1200	V [2]

Currents

Average forward current (averaged over any 20 ms period) T_{mb} = 75 °C	$I_{T(AV)}$	max.	70	A
T_{mb} = 85 °C	$I_{T(AV)}$	max.	60	A
Forward current (d.c.)	I_T	max.	110	A
R.M.S. forward current	$I_{T(RMS)}$	max.	110	A
Repetitive peak forward current	I_{TRM}	max.	1000	A
Non-repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	1050	A
I squared t for fusing (t ≤ 10 ms)	I^2t	max.	5600	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	50	A/μs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	30	A

1) To ensure thermal stability: $R_{th\ j\text{-}a} \leq 0.8$ °C/W (d.c.) or ≤ 1.5 °C/W (a.c.)
2) 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.

RATINGS (Limiting values) (continued)

ANODE TO CATHODE

Power dissipation

Non repetitive peak reverse dissipation				
$t = 10\ \mu s$; $T_j = 25\ ^oC$	P_{RSM}	max.	40	kW
$t = 10\ \mu s$; $T_j = 125\ ^oC$	P_{RSM}	max.	18	kW

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	10	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	1.0	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	$R_{th\ j\text{-}mb}$	=	0.3	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.015	$^oC/W$

OPERATING NOTES

See general pages at the beginning of this section.

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

		BTX49-600R	700R	800R	1000R	1200R	
Forward voltage I_T = 500 A; T_j = 25 °C	V_T	< 3.5	3.5	3.5	3.5	3.5	V [1]
Reverse breakdown voltage; T_j = 25 °C	$V_{(BR)R}$	> 700	800	900	1100	1300	V
		< 2500	2500	2500	2500	2500	V
Forward breakover voltage	$V_{(BO)}$	> 700	800	900	1100	1300	V
Currents							
Reverse current $V_R = V_{RWMmax}$	I_R	< 20	18	18	15	13	mA
Off-state current $V_D = V_{DWMmax}$	I_D	< 20	18	18	15	13	mA

Latching current	I_L	typ.	20	mA
Holding current at T_j = 25 °C	I_H	<	150	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

SWITCHING CHARACTERISTICS

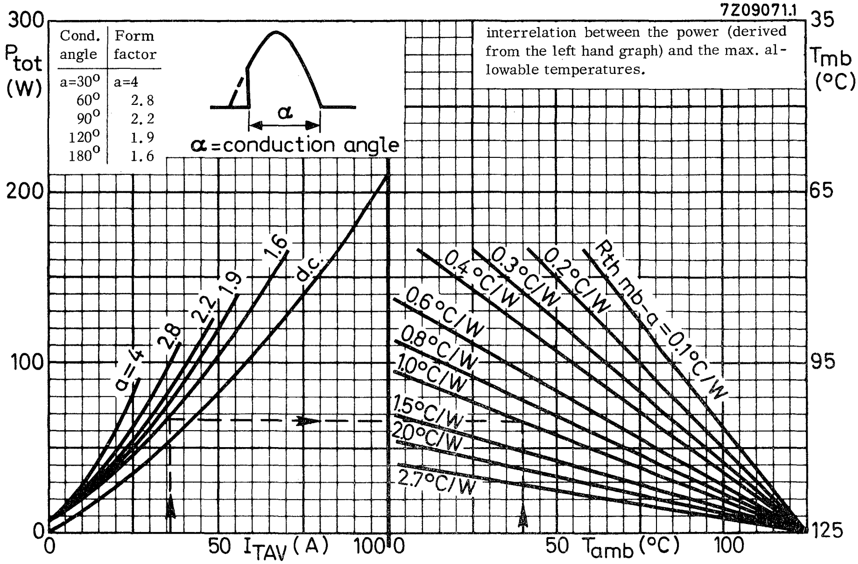
Turn-on time when switched from $V_D = V_{DWMmax}$ to I_T = 10 A

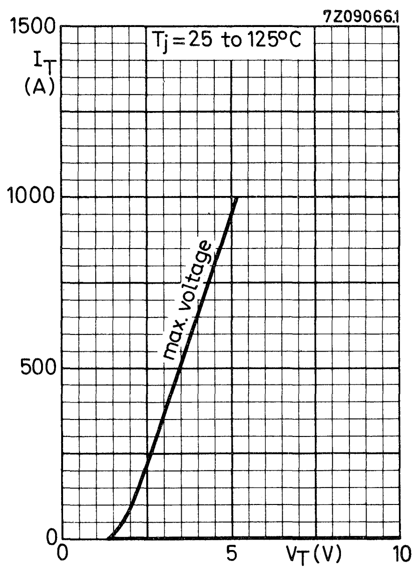
Gate source 5 V, 25 Ω	t_{on}	typ.	5.0	µs

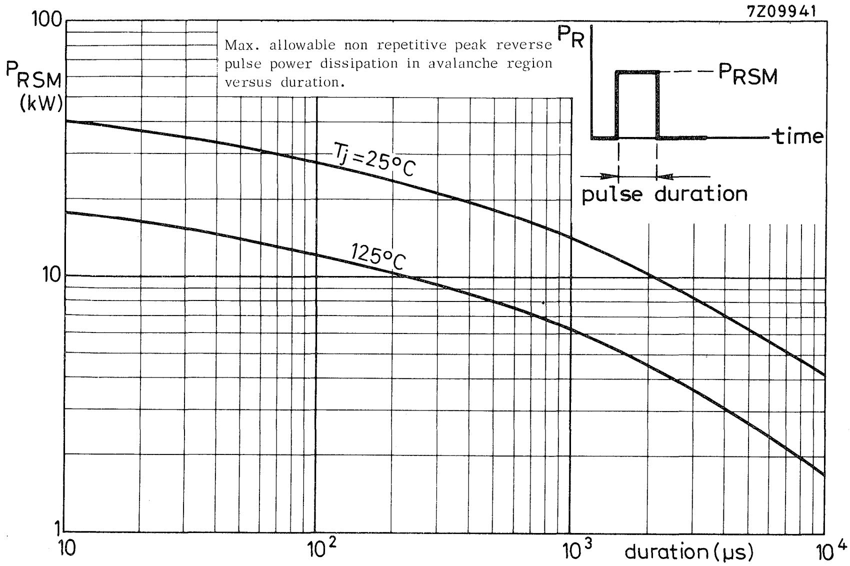
Turn-off time when switched from I_T = 50 A to $V_R \geq$ 50 V with $-dI/dt$ = 50 A/µs; dV_D/dt = 10 V/µs

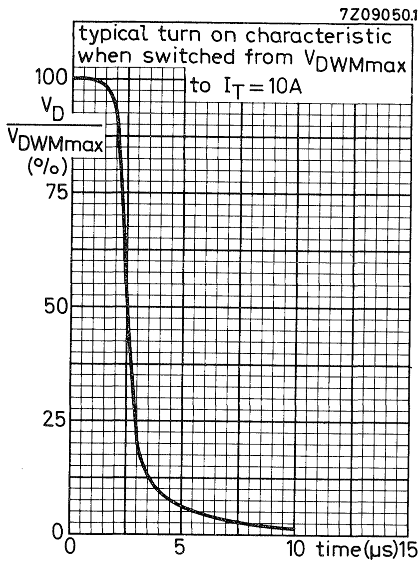
T_j = 125 °C	t_q	<	250	µs
T_j = 25 °C	t_q	<	100	µs

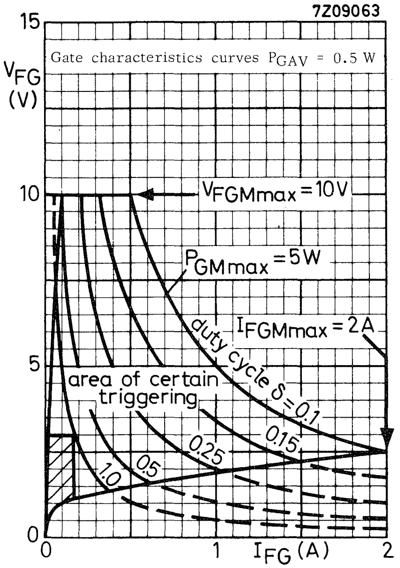
1) Measured under pulsed conditions to avoid excessive dissipation.

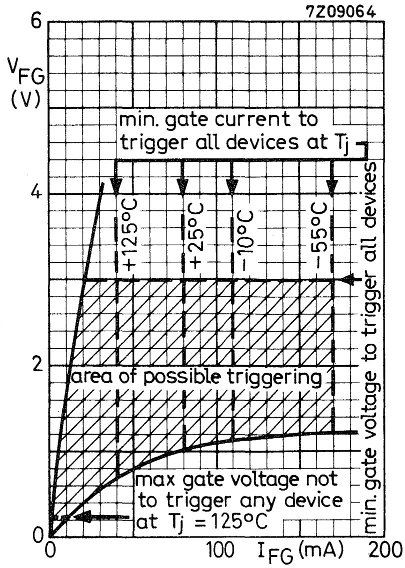

7Z09071.1
300
200
100
0
P_{tot} (W)
Cond. angle | Form factor
a=30° a=4
60° 2.8
90° 2.2
120° 1.9
180° 1.6
α
α=conduction angle
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures.
35
65
95
125
T_{mb} (°C)
a=4
2.8
2.2
1.9
1.6
d.c.
0.4 °C/W
0.3 °C/W
0.2 °C/W
Rth mb-a = 0.1 °C/W
0.6 °C/W
0.8 °C/W
1.0 °C/W
1.5 °C/W
2.0 °C/W
2.7 °C/W
0
50
I_{TAV} (A)
100
0
50
T_{amb} (°C)
100

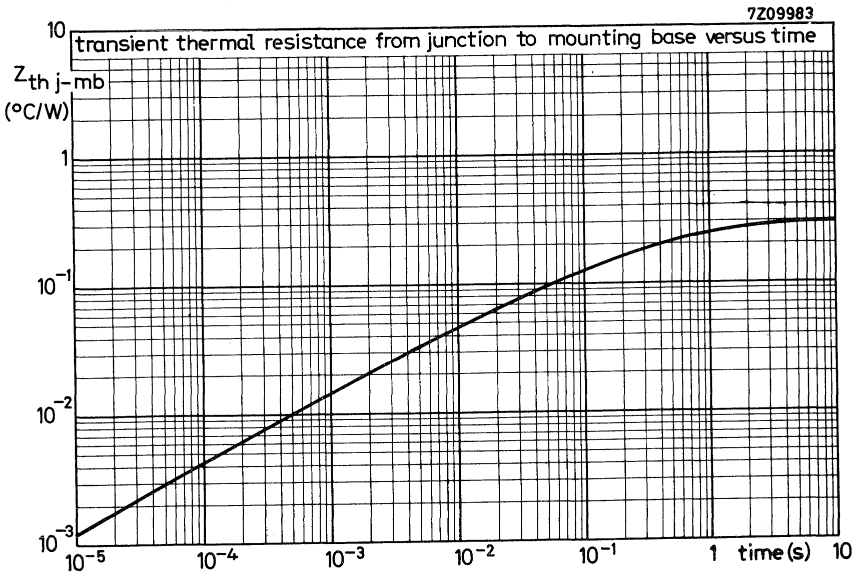

7Z09066.1
1500
1000
500
0
I_T (A)
T_j = 25 to 125°C
max. voltage
0
5
V_T (V)
10

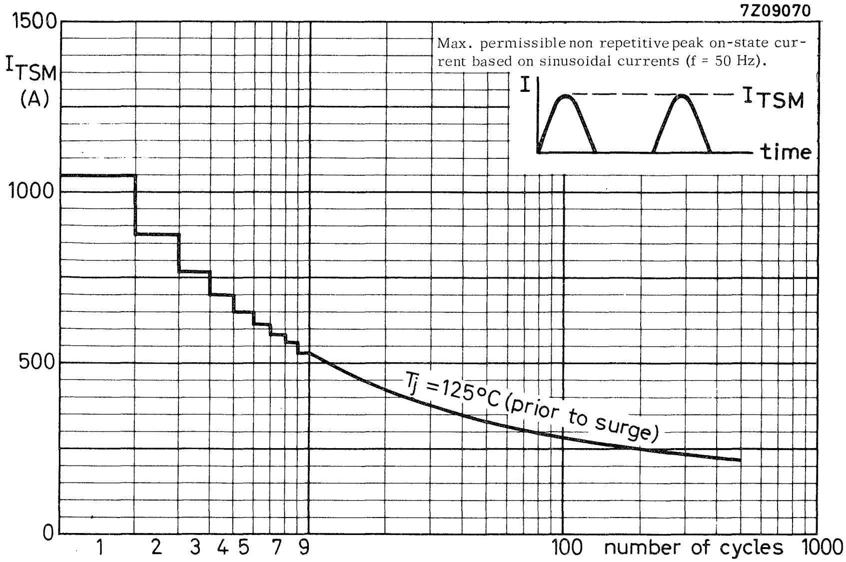

7Z09941
Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration.
P_{RSM} (kW)
100
10
1
10
10^2
10^3
duration (μs)
10^4
$T_j = 25°C$
125°C
P_R
P_{RSM}
time
pulse duration

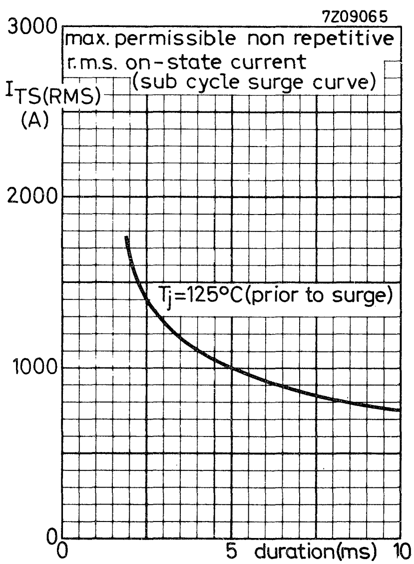

7Z09050.1
typical turn on characteristic when switched from V_{DWMmax} to $I_T = 10A$
$\frac{V_D}{V_{DWMmax}}$ (%)
100
75
50
25
0
0
5
10
time (μs)
15

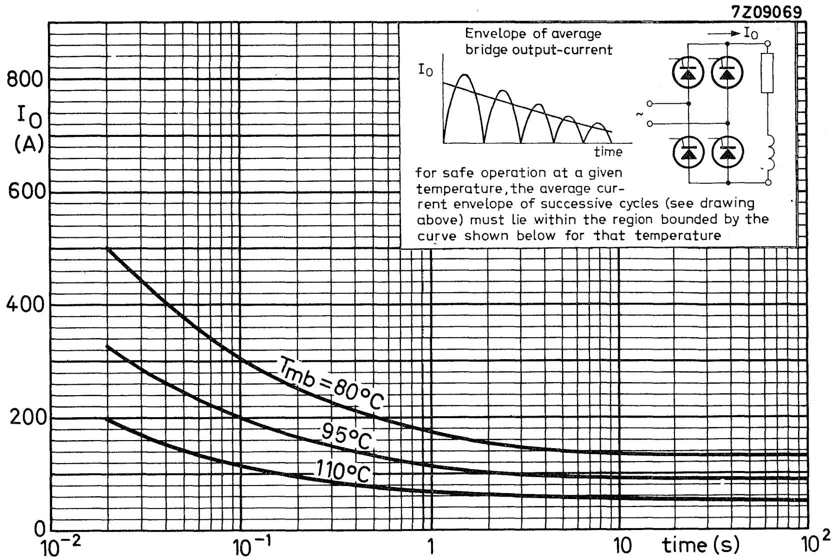

7Z09063
Gate characteristics curves P_{GAV} = 0.5 W
V_{FG} (V)
15
10
5
0
V_{FGMmax} = 10 V
P_{GMmax} = 5 W
I_{FGMmax} = 2 A
duty cycle δ = 0.1
0.15
0.25
0.5
1.0
area of certain triggering
0
1
I_{FG} (A)
2

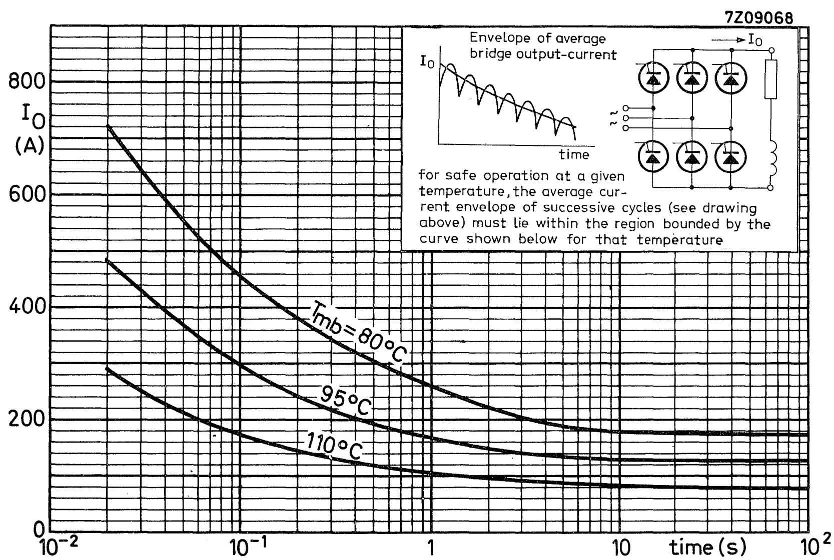

7Z09064
V_{FG} (V)
6
4
2
0
min. gate current to trigger all devices at T_j
+125°C
+25°C
−10°C
−55°C
min. gate voltage to trigger all devices
area of possible triggering
max gate voltage not to trigger any device at T_j = 125°C
0
100
I_{FG} (mA)
200


7Z09983
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j-mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

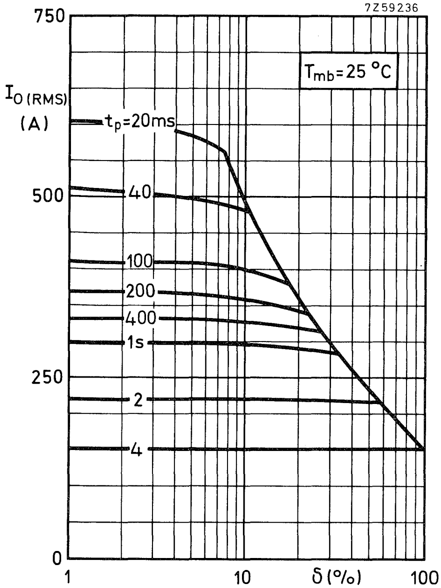

7Z09070
1500
I_{TSM}
(A)
1000
500
0
1
2
3 4 5 7 9
100
number of cycles
1000
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz).
I
I_{TSM}
time
T_j =125°C (prior to surge)

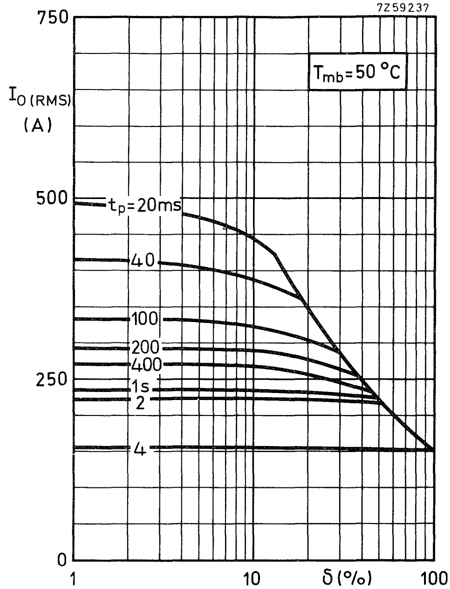

7Z09065
3000
$I_{TS(RMS)}$
(A)
2000
1000
0
0
5
duration(ms)
10
max. permissible non repetitive
r.m.s. on-state current
(sub cycle surge curve)
T_j=125°C(prior to surge)

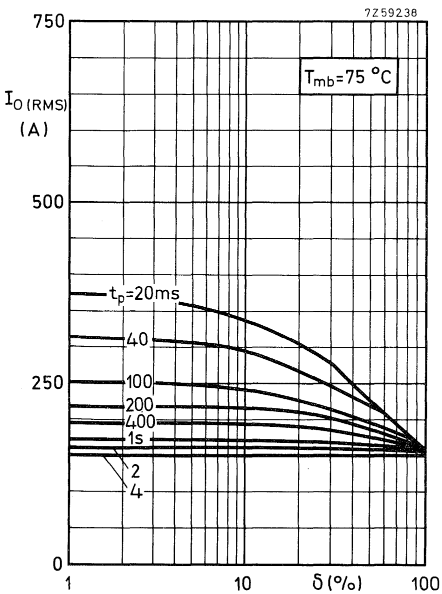

7Z09069
Envelope of average
bridge output-current
I_O
time
for safe operation at a given temperature, the average current envelope of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
800
I_O
(A)
600
400
200
0
T_{mb} = 80 °C
95 °C
110 °C
10^{-2}
10^{-1}
1
10
time (s)
10^2

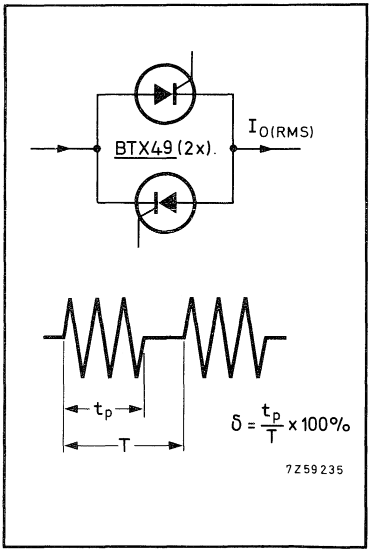

7Z09068
Envelope of average
bridge output-current
I_O
time
for safe operation at a given temperature, the average current envelope of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
800
I_O
(A)
600
400
200
0
T_{mb} = 80 °C
95 °C
110 °C
10^{-2}
10^{-1}
1
10
time (s)
10^2

intermittent overload capability of two BTX49 thyristors in antiparallel connection in a single phase a.c. control circuit (e.g. welding).







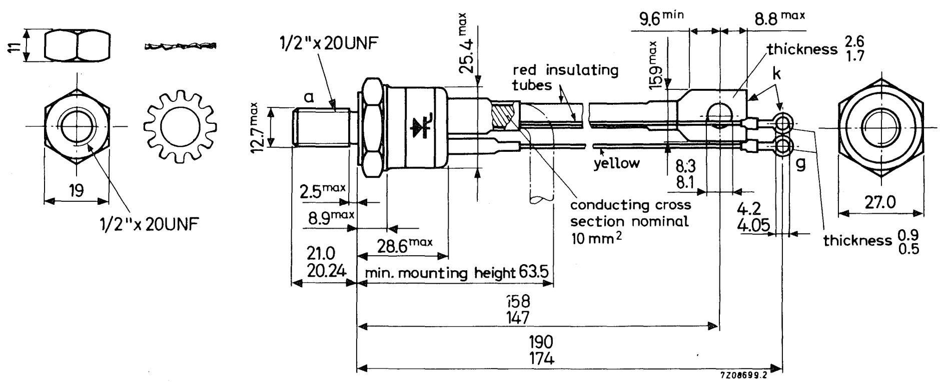


CONTROLLED AVALANCHE THYRISTORS

P-gate silicon thyristors in a TO-94 metal envelope with ceramic insulation. They are capable of absorbing transients and intended for power control and power switching applications (d.c. motor speed control, furnaces and lighting). The series consists of reverse polarity types (anode to stud): BTX50-600R to BTX-1200R.

QUICK REFERENCE DATA							
		BTX50-600R	700R	800R	1000R	1200R	
V_{RWM}	max.	600	700	800	1000	1200	V
V_{DWM}	max.	600	700	800	1000	1200	V
$V_{(BR)R}$	>	700	800	900	1100	1300	V
$V_{(BO)}$	>	700	800	900	1100	1300	V
Average forward current at T_{mb} = 85 °C		$I_{T(AV)}$	max.	70	A		
Non-repetitive peak forward current t = 10 ms		I_{TSM}	max.	1500	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		

MECHANICAL DATA Dimensions in mm
TO-94



Torque on nut: min. 90 kg cm
max. 175 kg cm

Net weight: 108 g

Diameter of clearance hole: max. 13 mm

All information applies to frequencies up to 400 Hz

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

ANODE TO CATHODE

Voltages [1]

		BTX50-600R	700R	800R	1000R	1200R	
V_R	max.	600	700	800	1000	1200	V
V_{RWM}	max.	600	700	800	1000	1200	V
V_D	max.	600	700	800	1000	1200	V
V_{DWM}	max.	600	700	800	1000	1200	V [2]

Currents

Average forward current (averaged over any 20 ms period) T_{mb} = 85 °C	$I_{T(AV)}$	max.	70	A
Forward current (d.c.)	I_T	max.	110	A
R.M.S. forward current	$I_{T(RMS)}$	max.	110	A
Repetitive peak forward current	I_{TRM}	max.	1000	A
Non-repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	1500	A
I squared t for fusing ($t \leq 10$ ms)	I^2t	max.	10000	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	50	A/μs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	30	A

[1]) To ensure thermal stability: $R_{th\ j\text{-}a} \leq 0.8$ °C/W (d.c.) or ≤ 1.5 °C/W (a.c.)

[2]) 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.

RATINGS (Limiting values) (continued)

ANODE TO CATHODE

Power dissipation

Non repetitive peak reverse dissipation				
$t = 10\ \mu s$; $T_j = 25\ ^oC$	P_{RSM}	max.	40	kW
$t = 10\ \mu s$; $T_j = 125\ ^oC$	P_{RSM}	max.	18	kW

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	10	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	1.0	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	$R_{th\ j\text{-}mb}$	=	0.3	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.015	$^oC/W$

OPERATING NOTES

See general pages at the beginning of this section.

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages			BTX50-600R	700R	800R	1000R	1200R	
Forward voltage I_T = 500 A; T_j = 25 °C	V_T	<	2.5	2.5	2.5	2.5	2.5	V [1]
Reverse breakdown voltage; T_j = 25 °C	$V_{(BR)R}$	>	700	800	900	1100	1300	V
		<	2500	2500	2500	2500	2500	V
Forward breakover voltage	$V_{(BO)}$	>	700	800	900	1100	1300	V
Currents								
Reverse current $V_R = V_{RWMmax}$	I_R	<	20	18	18	15	13	mA
Off-state current $V_D = V_{DWMmax}$	I_D	<	20	18	18	15	13	mA

Latching current	I_L	typ.	20	mA
Holding current at T_j = 25 °C	I_H	<	150	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

SWITCHING CHARACTERISTICS

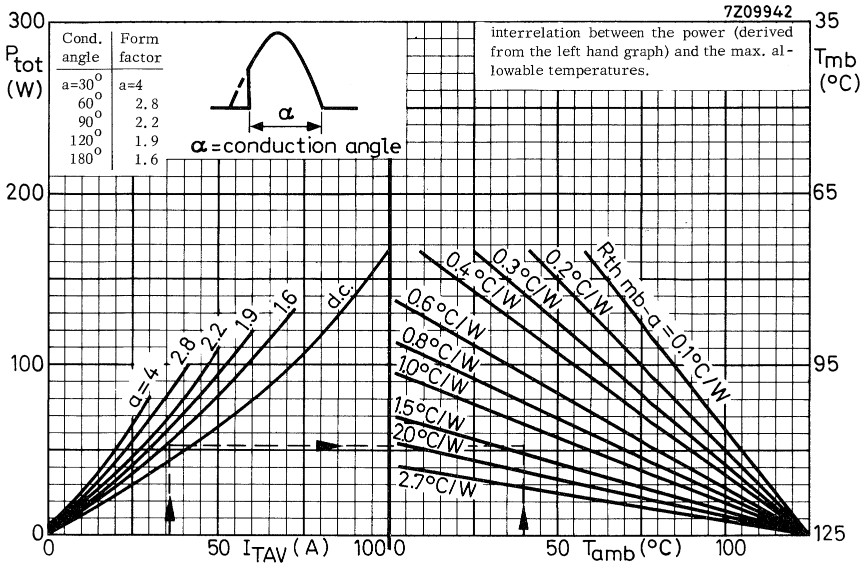
Turn-on time when switched from $V_D = V_{DWMmax}$ to I_T = 10 A

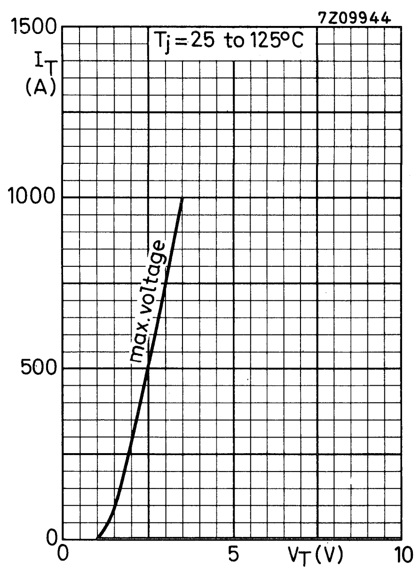
Gate source 5 V, 25 Ω — t_{on} typ. 5.0 μs

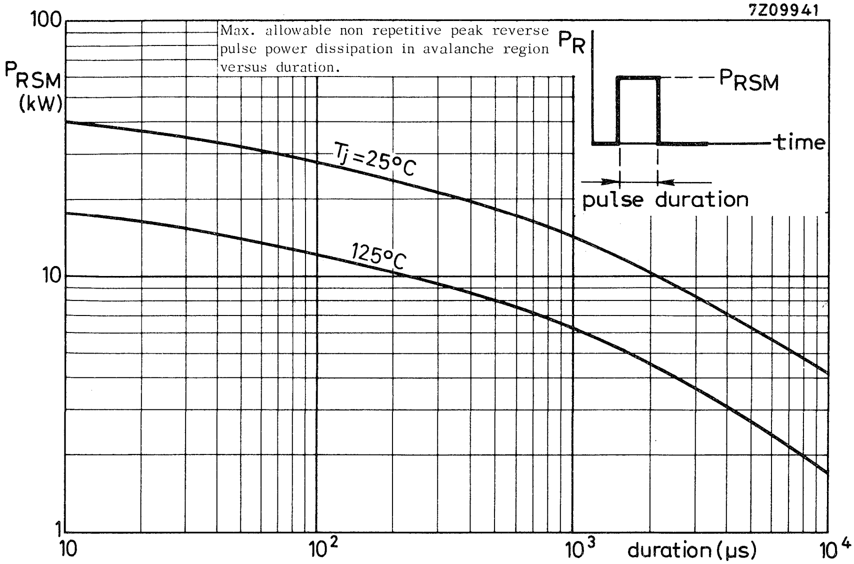
Turn-off time when switched from I_T = 50 A to $V_R \geq$ 50 V with $-dI/dt$ = 50 A/μs; dV_D/dt = 10 V/μs

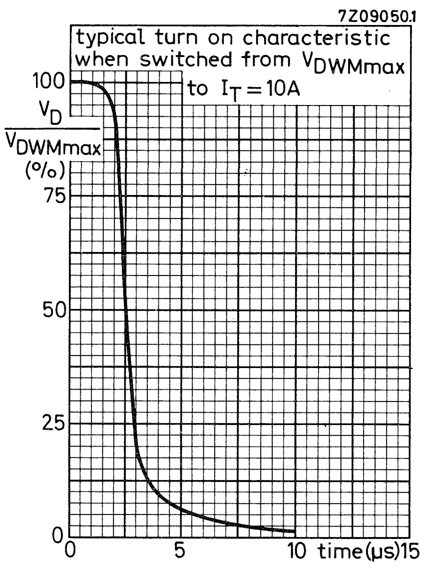
T_j = 125 °C	t_q	<	250	μs
T_j = 25 °C	t_q	<	100	μs

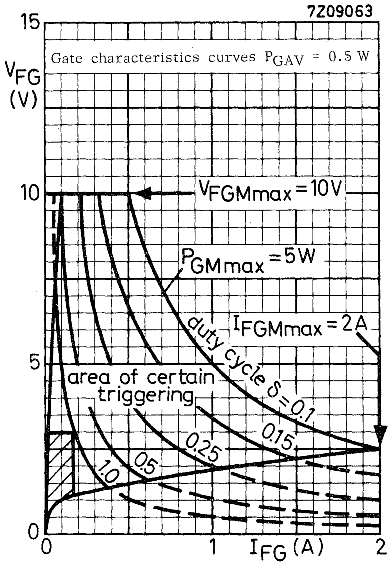
[1]) Measured under pulsed conditions to avoid excessive dissipation.

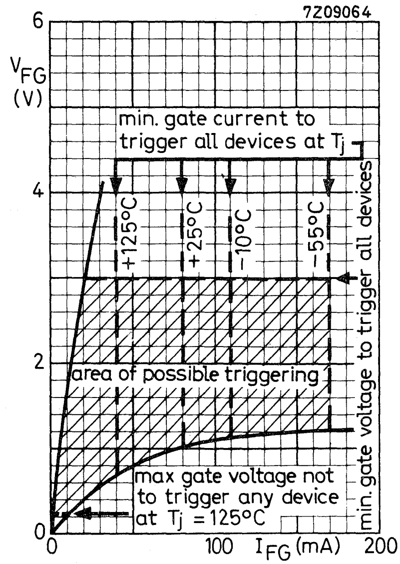

7Z09942
300
P_{tot}
(W)
200
100
0
Cond. angle
Form factor
a=30°
a=4
60°
2.8
90°
2.2
120°
1.9
180°
1.6
α
α = conduction angle
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures.
a = 4
2.8
2.2
1.9
1.6
d.c.
0.4 °C/W
0.3°C/W
0.2°C/W
Rth mb-a = 0.1°C/W
0.6 °C/W
0.8°C/W
1.0°C/W
1.5°C/W
2.0°C/W
2.7°C/W
0
50 I_{TAV} (A)
100
0
50 T_{amb} (°C)
100
35
T_{mb}
(°C)
65
95
125

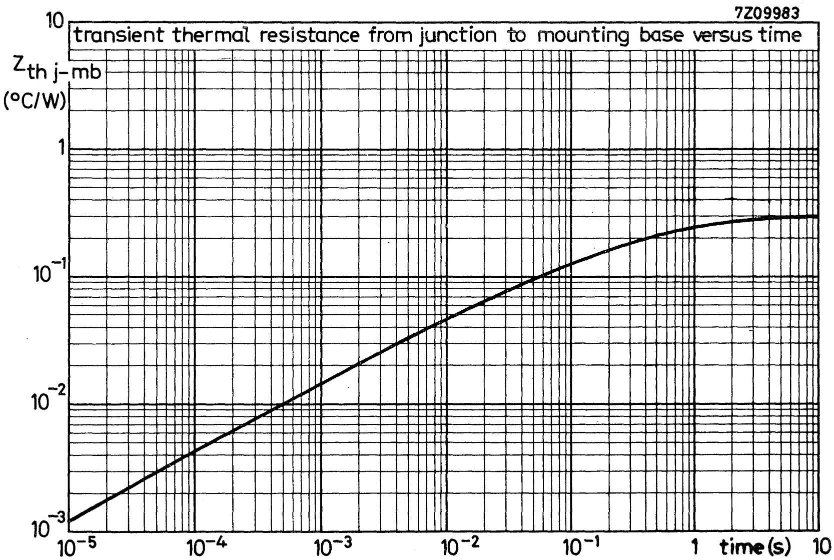

7Z09944
1500
I_T
(A)
1000
500
0
T_j = 25 to 125°C
max. voltage
0
5
V_T (V)
10

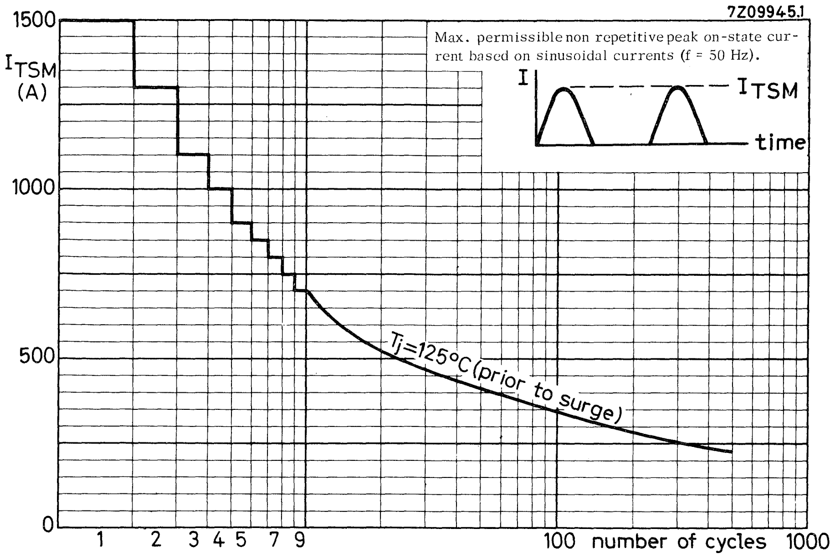

7Z09941
Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration.
P_{RSM} (kW)
100
10
1
10
10^2
10^3
duration (μs)
10^4
$T_j = 25^\circ C$
$125^\circ C$
P_R
P_{RSM}
time
pulse duration

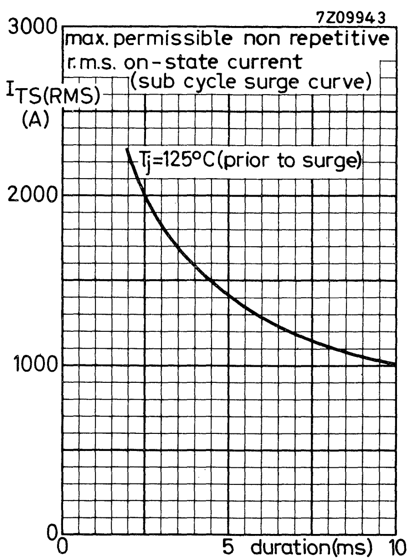

7Z09050.1
typical turn on characteristic when switched from V_{DWMmax} to $I_T = 10A$
$\frac{V_D}{V_{DWMmax}}$ (%)
100
75
50
25
0
0
5
10
time (μs)
15


7Z09063
Gate characteristics curves P_{GAV} = 0.5 W
V_{FG} (V)
V_{FGMmax} = 10V
P_{GMmax} = 5W
I_{FGMmax} = 2A
duty cycle δ = 0.1
0.15
0.25
0.5
1.0
area of certain triggering
I_{FG} (A)

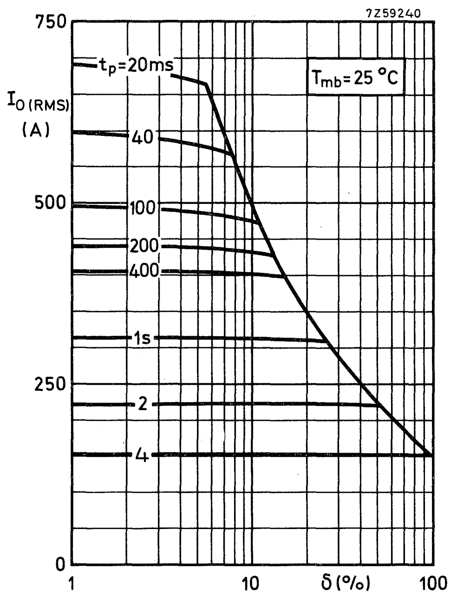

7Z09064
V_{FG} (V)
min. gate current to trigger all devices at T_j
+125°C
+25°C
−10°C
−55°C
area of possible triggering
min. gate voltage to trigger all devices
max gate voltage not to trigger any device at T_j = 125°C
I_{FG} (mA)

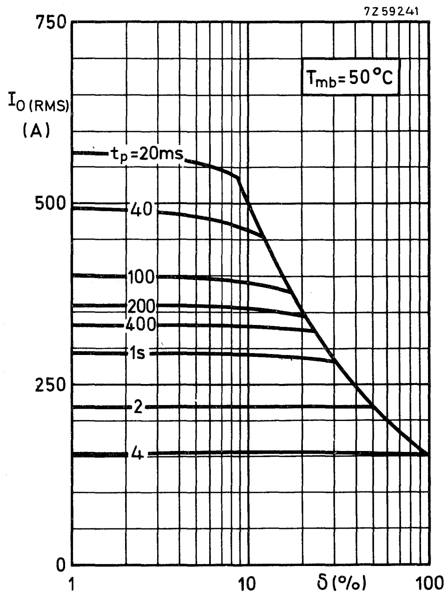

7Z09983
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j-mb}$ (°C/W)
time (s)

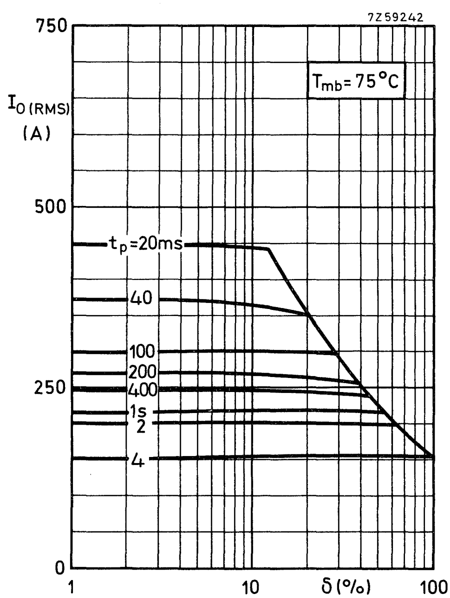

7Z09945.1
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz).
I
I_{TSM}
time
1500
I_{TSM}
(A)
1000
500
0
1
2
3
4
5
7
9
100
number of cycles
1000
T_j=125°C (prior to surge)

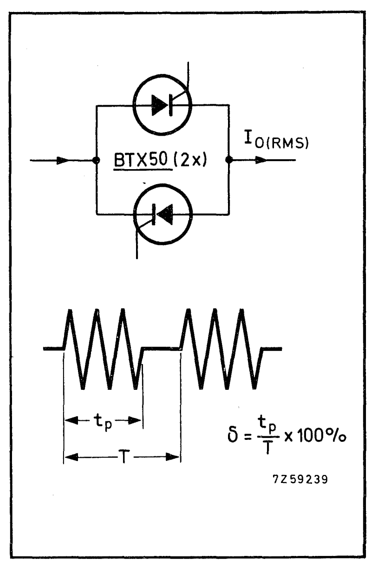

7Z09943
max. permissible non repetitive
r.m.s. on-state current
(sub cycle surge curve)
3000
$I_{TS(RMS)}$
(A)
2000
1000
0
0
5
duration(ms)
10
T_j=125°C (prior to surge)

intermittent overload capability of two BTX50 thyristors in antiparallel connection in a single phase a.c. control circuit (e.g. welding).









CONTROLLED AVALANCHE THYRISTORS

P-gate silicon thyristors in a TO-64 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):
BTX68-500R; BTX68-600R; BTX68-700R; BTX68-800R and BTX68-1000R.

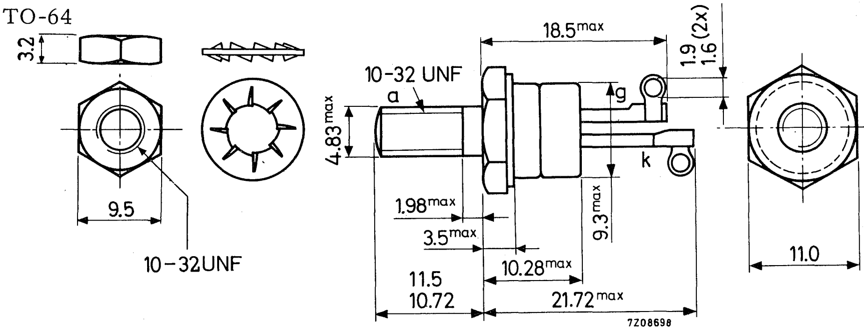
QUICK REFERENCE DATA

			BTX68-500R	600R	700R	800R	1000R	
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	1000	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	1000	V

Average forward current; $T_{mb} = 85\ ^{o}C$	I_{TAV}	max.	6.4	A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	80	A
Non repetitive peak reverse power dissipation t = 10 μs; T_j = 25 ^{o}C	P_{RSM}	max.	12	kW
Junction temperature	T_j	max.	125	^{o}C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0	$^{o}C/W$

MECHANICAL DATA Dimensions in mm

TO-64



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
Accessories available : 56295 (56262A)

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]			BTX68-500R	600R	700R	800R	1000R	
Continuous reverse voltage	V_R	max.	500	600	700	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	1000	V
Continuous off-state voltage	V_D	max.	500	600	700	800	1000	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	1000	V [3]

Currents

Average forward current (averaged over any 20 ms period) $T_{amb} = 85\ ^oC$	I_{TAV}	max.	6.4	A
Forward current (d.c.)	I_T	max.	10	A
Repetitive peak forward current	I_{TRM}	max.	60	A
Non repetitive peak forward current t = 10 ms (See also page 7)	I_{TSM}	max.	80	A
I squared t for fusing (t < 10 ms)	I^2t	max.	32	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/μs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	5	A

Power dissipation

Non repetitive peak reverse dissipation

t = 10 μs; T_j = 25 ^oC	P_{RSM}	max.	12	kW
t = 10 μs; T_j = 125 ^oC	P_{RSM}	max.	4	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.
To ensure thermal stability: $R_{th\ j\text{-}a} \leqq 6.0\ ^oC/W$ (d.c.) or $\leqq 12\ ^oC/W$ (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.

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	$R_{th\ j\text{-}mb}$	=	3.0	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	$^oC/W$
From mounting base to heatsink mounted with 56295	$R_{th\ mb\text{-}h}$	=	4.0	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.16	$^oC/W$

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTX68-500R	600R	700R	800R	1000R	
Forward on-state voltage I_T = 20 A; T_j = 25 °C	V_T	<	2.3	2.3	2.3	2.3	2.3	V [1]
Reverse breakdown voltage in avalanche region	$V_{(BR)R}$	>	550	660	770	880	1000	V
Forward breakover voltage	$V_{(BO)}$	>	550	660	770	880	1000	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	<	2.5	mA [2]
Off-state current $V_D = V_{DWMmax}$	I_D	<	2.5	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}	>	30	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.

SWITCHING CHARACTERISTICS

Turn-on time when switched from
V_D = 50 V to I_T = 10 A

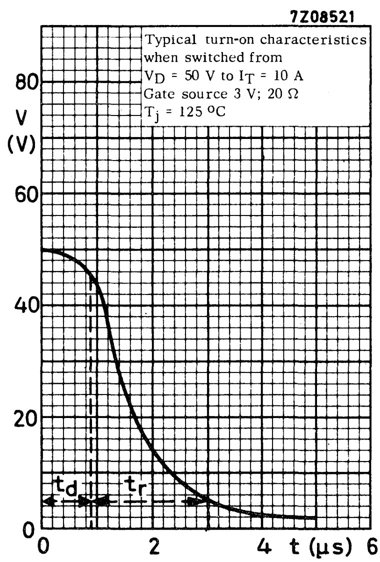
Gate source 3 V, 20 Ω, T_j = 125 °C	t_{on}	typ.	3.0	μs

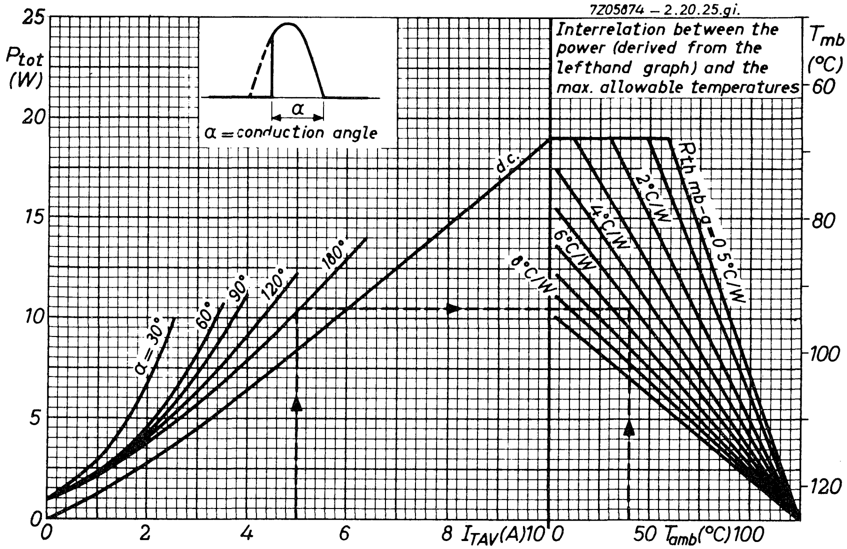
Turn-off time when switched from
I_T = 5 A to $V_R \geq$ 50 V with
$-dI/dt$ = 5 A/μs; dV_D/dt = 10 V/μs

T_j = 125 °C	t_q	<	100 μs
T_j = 25 °C	t_q	<	50 μs

OPERATING NOTES (See also general pages at the beginning of this section)

The gate and cathode connectors should not be bent or twisted: they should be soldered into the circuit so that 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.





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 $T_{amb} = 40\ ^{\circ}C$.

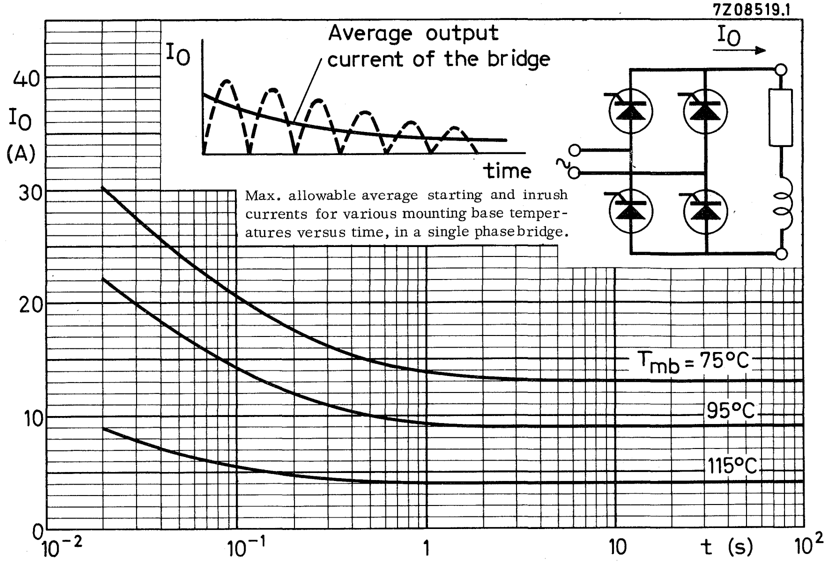
$$R_{th\ mb\text{-}a} \approx 5.2\ ^{\circ}C/W$$

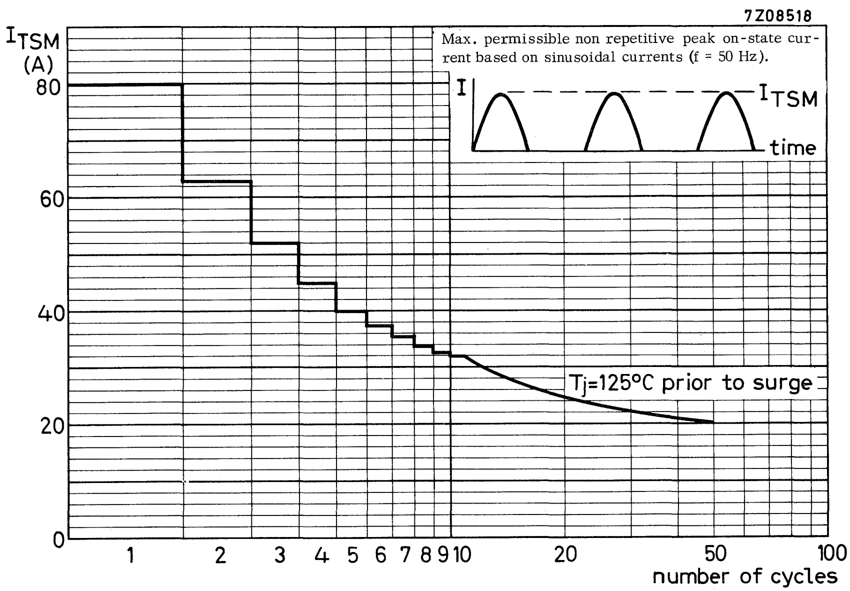
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.5\ ^{\circ}C/W$

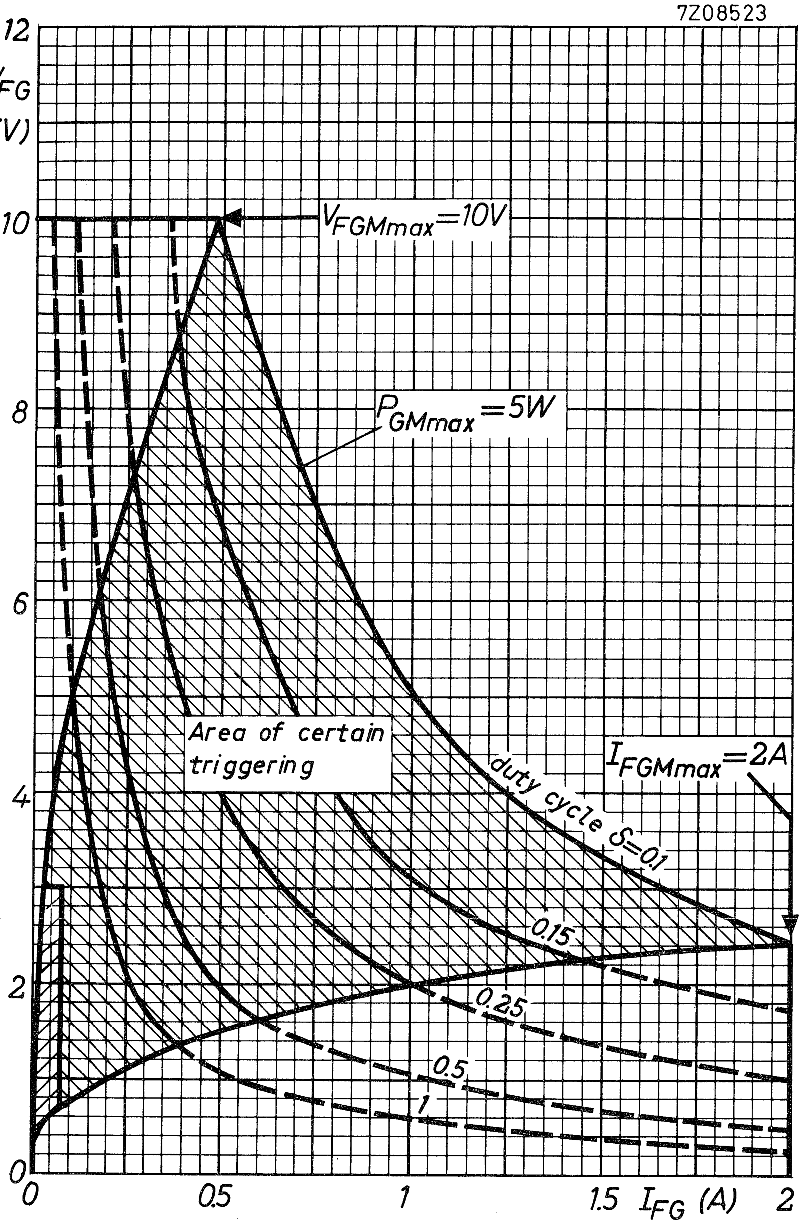
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (5.2 - 0.5)\ ^{\circ}C/W = 4.7\ ^{\circ}C/W$$

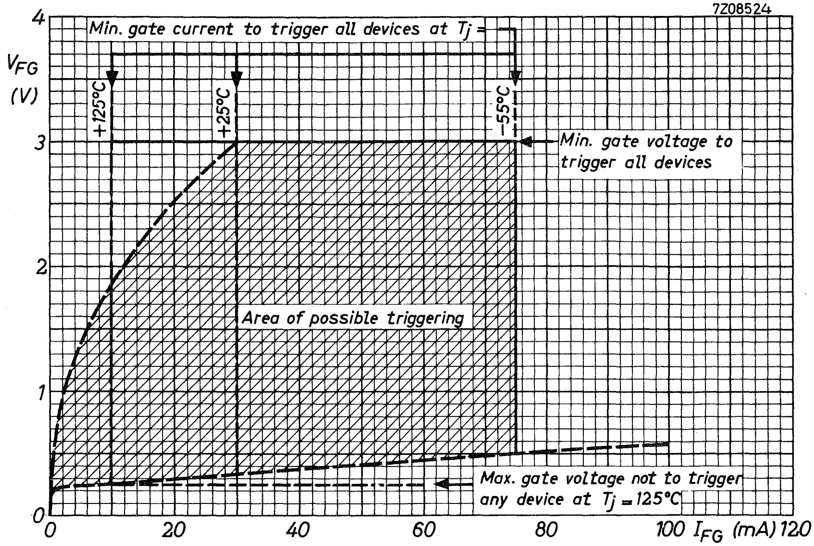
The applicable heatsink(s) may then be found in the Section HEATSINKS.

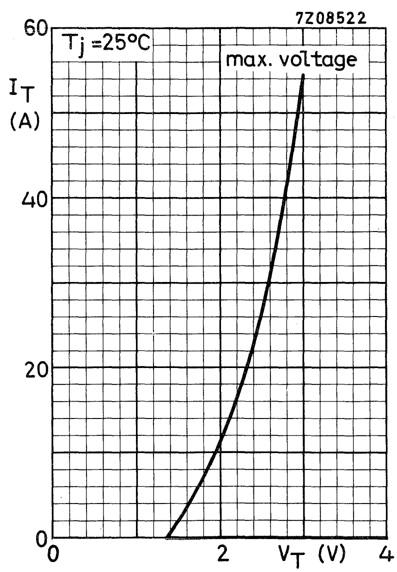

7Z08519.1
Average output current of the bridge
I_O
time
Max. allowable average starting and inrush currents for various mounting base temperatures versus time, in a single phasebridge.
I_O (A)
40
30
20
10
0
T_{mb} = 75°C
95°C
115°C
10^{-2}
10^{-1}
1
10
t (s)
10^2

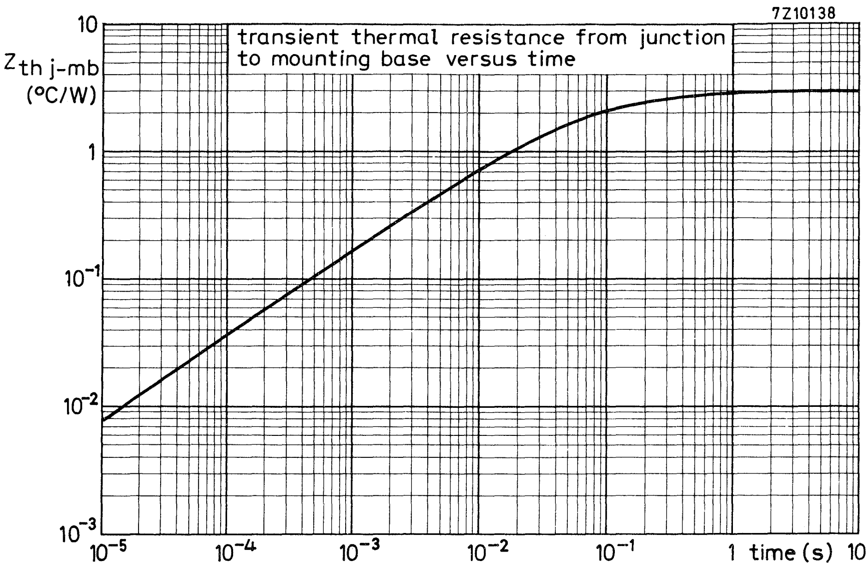

7Z08518
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz).
I
I_{TSM}
time
I_{TSM} (A)
80
60
40
20
0
Tj=125°C prior to surge
1
2
3
4
5
6
7
8
9
10
20
50
100
number of cycles



Gate characteristics with curves $P_{GAV}=0.5W$


7Z08524
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
20
40
60
80
100
120
1
2
3
4


7Z08522
T_j = 25°C
max. voltage
I_T
(A)
V_T (V)
0
2
4
20
40
60


7Z10138
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

SILICON THYRISTORS

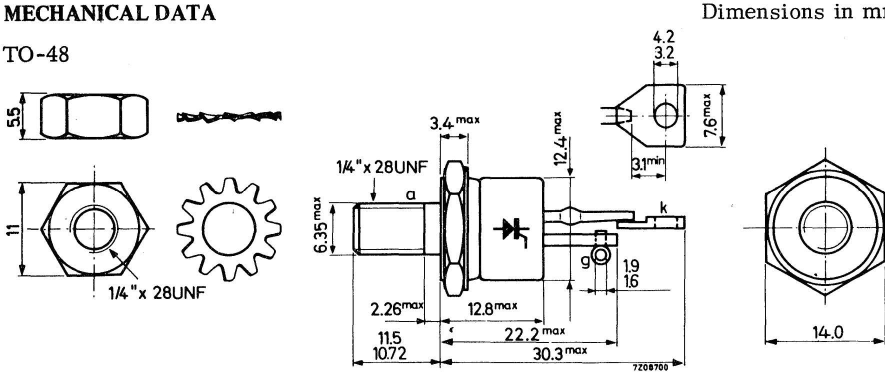
P-gate thyristors in a TO-48 metal envelope. They are intended for medium power applications, a.o. d.c. motor-speed control, furnaces and lighting. The series consists of reverse polarity types (anode to stud) BTX81-400R to BTX81-800R.

QUICK REFERENCE DATA							
		BTX81 - 400R	500R	600R	700R	800R	
Crest working voltages	$V_{DWM} = V_{RWM}$	max. 400	500	600	700	800	V
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max. 400	500	600	700	800	V

Average on-state current $T_{mb} = 85\ ^{o}C$	$I_{T(AV)}$	max.	20	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	31	A
Non-repetitive peak on-state current (t = 10 ms; half sine wave)	I_{TSM}	max.	450	A
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	20	A/µs

MECHANICAL DATA Dimensions in mm

TO-48



Net weight : 15 g
Diameter of clearance hole : max. 6.5 mm
Accessories supplied on request: 56264A

Torque on nut: min. 17 kg cm (1.7 Newton-metres)
max. 35 kg cm (3.5 Newton-metres)

All information applies to frequencies up to 400 Hz.

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

ANODE TO CATHODE

			BTX81 - 400R	500R	600R	700R	800R	
Voltages 1)								
Continuous reverse voltage	V_R	max.	400	500	600	700	800	V
Crest working voltages 2)	$V_{DWM} = V_{RWM}$	max.	400	500	600	700	800	V
Repetitive peak voltages 2)	$V_{DRM} = V_{RRM}$	max.	400	500	600	700	800	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	500	600	720	850	960	V
Continuous off-state voltage	V_D	max.	400	500	600	700	800	V
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	500	850	850	850	850	V

Currents

Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 85\ ^oC$	$I_{T(AV)}$	max.	20	A
On state current (d. c.)	I_T	max.	31	A
R. M. S. on-state current	$I_{T(RMS)}$	max.	31	A
Repetitive peak on-state current	I_{TRM}	max.	200	A
Non-repetitive peak on-state current ($t = 10$ ms; half sine wave) $T_j = 125\ ^oC$ prior to surge	I_{TSM}	max.	450	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	1000	A^2s
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	20	A/µs

1) To ensure thermal stability: $R_{th\ j-a} \leq 3.0\ ^oC/W$ (d. c. blocking) or $\leq 5.5\ ^oC/W$ (a. c.)

2) Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (see page **4**) the thyristor may switch into the on-state.

RATINGS (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5.0	V

Current

Forward peak current	I_{FGM}	max.	2.0	A

Power dissipation

Average power dissipation	P_{GAV}	max.	1	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	$R_{th\ j\text{-}mb}$	=	1.0	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.05	$^oC/W$

CHARACTERISTICS

ANODE TO CATHODE

Voltages

			BTX81 - 400R	500R	600R	700R	800R	
On-state voltage $I_T = 50$ A; $T_j = 25$ °C	V_T	<	1.8	1.8	1.8	1.8	1.8	V
Forward breakover voltage up to $T_j = 125$ °C	$V_{(BO)}$	>	400	500	600	700	800	V

Currents

Peak reverse current $V_R = V_{RWM\,max}$; $T_j = 125$ °C	I_{RM}	<	10	8	8	7	6	mA
Peak off-state current $V_D = V_{DWM\,max}$; $T_j = 125$ °C	I_{DM}	<	10	8	8	7	6	mA

Latching current; $T_j = 25$ °C	I_L	<	200	mA
Holding current; $T_j = 25$ °C	I_H	<	100	mA

GATE TO CATHODE

Voltages

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	3.5	V
Voltage that will not trigger any device $V_D = V_{DRM\,max}$; $T_j = 125$ °C	V_{GD}	<	0.25	V

Current

Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	80	mA

SWITCHING CHARACTERISTICS

Turn-on time when switched from

$V_D = V_{DWM\,max}$ to $I_T = 10$ A; $T_j = 25$ °C — t_{on} typ. 5 µs

→ Turn-off time when switched from

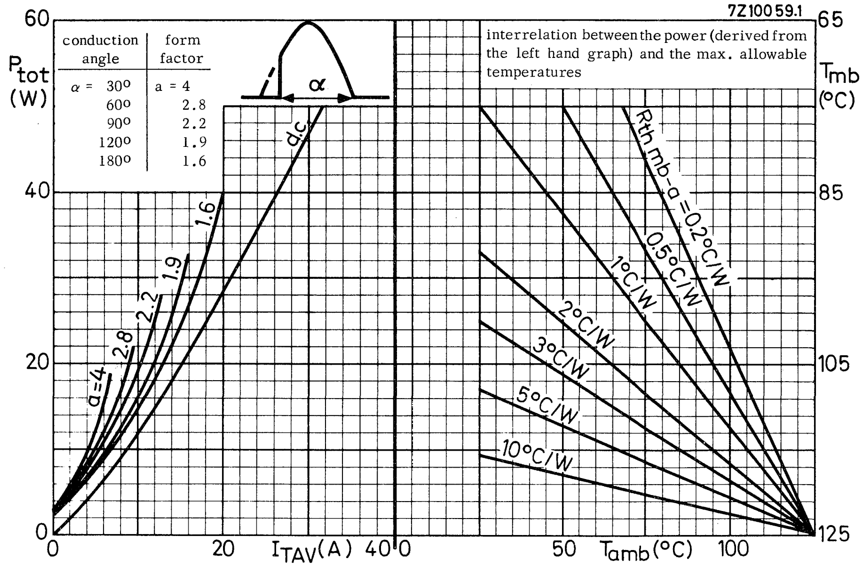
$I_T = 20$ A to $V_R \geq 50$ V with

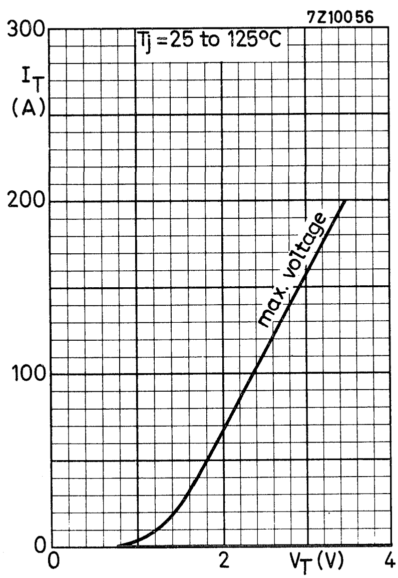
$-dI/dt = 20$ A/µs; $dV_D/dt = 10$ V/µs

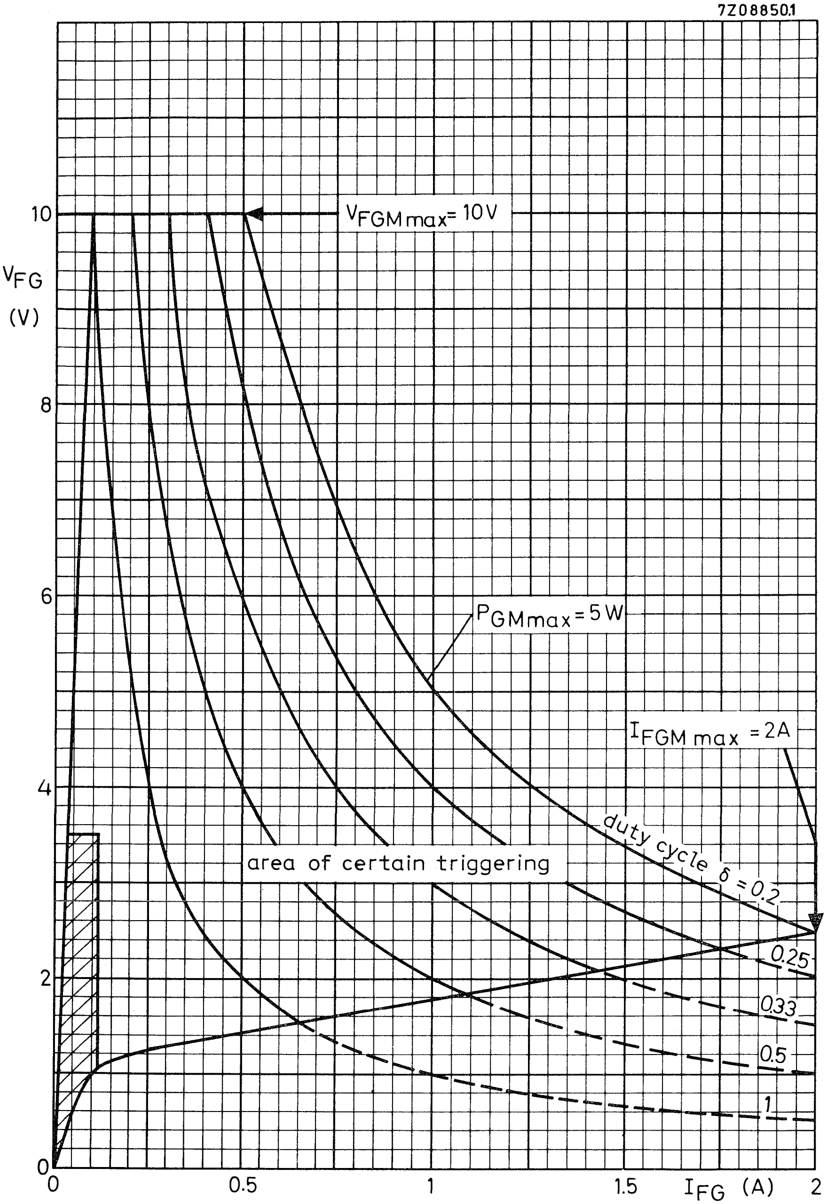
$T_j = 125$ °C	t_q	typ.	250	µs
$T_j = 25$ °C	t_q	<	100	µs

OPERATING NOTES

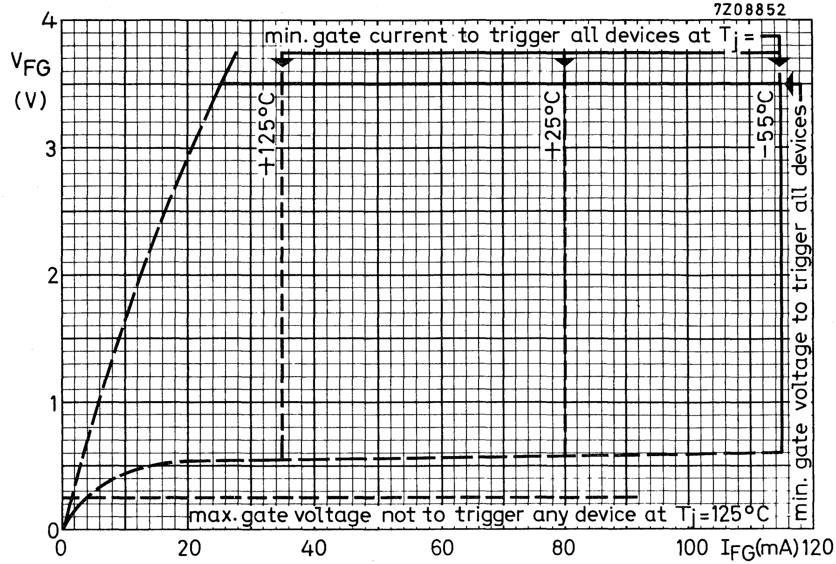
See general pages at the beginning of this section.

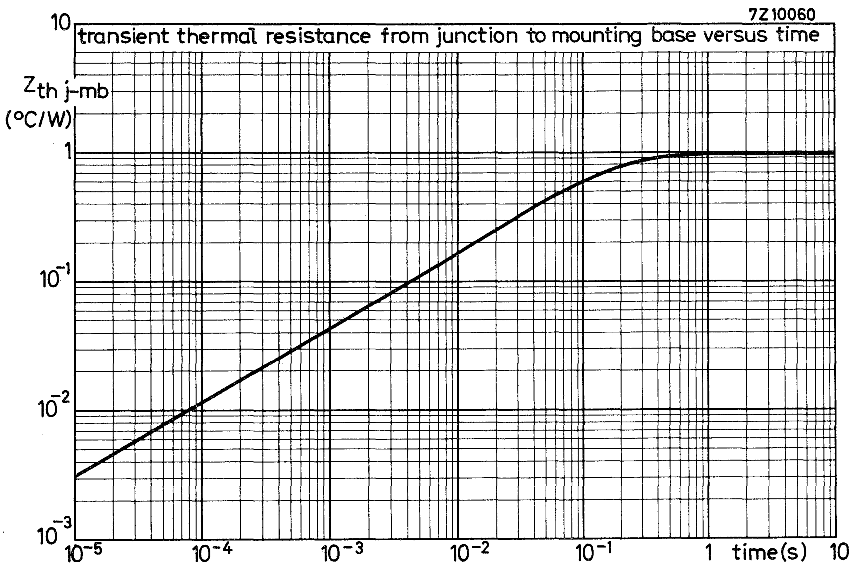

7Z10059.1
conduction angle
form factor
α = 30° a = 4
60° 2.8
90° 2.2
120° 1.9
180° 1.6
α
d.c.
1.6
1.9
2.2
2.8
a=4
P_{tot} (W)
I_{TAV} (A)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
$R_{th\,mb-a}$ = 0.2°C/W
0.5°C/W
1°C/W
2°C/W
3°C/W
5°C/W
10°C/W
T_{mb} (°C)
T_{amb} (°C)
60
40
20
0
65
85
105
125
50
100


7Z10056
T_j = 25 to 125°C
max. voltage
I_T (A)
V_T (V)
300
200
100
0
2
4

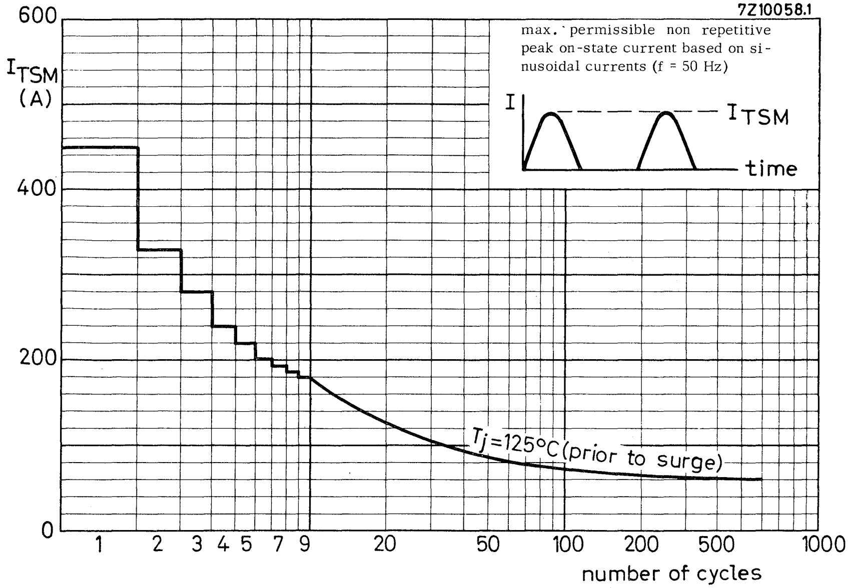


Gate characteristics with curves $P_{GAV} = 1\,W$

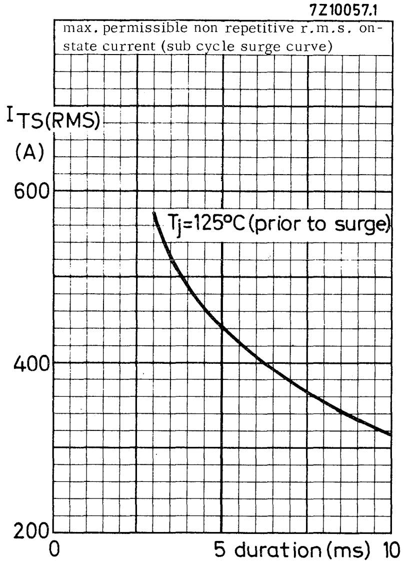

7Z08852
4
V_{FG}
(V)
3
2
1
0
0
20
40
60
80
100
I_{FG}(mA)
120
min. gate current to trigger all devices at T_j =
+125 °C
+25 °C
−55 °C
min. gate voltage to trigger all devices
max. gate voltage not to trigger any device at T_j = 125 °C


7Z10060
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time(s)
10

7Z10058.1



7Z10057.1



SILICON THYRISTORS

P-gate thyristors in a TO-48 metal envelope. They are intended for medium power applications, a.o. d.c. motor-speed control, furnaces and lighting. The series consists of reverse polarity types (anode to stud) BTX82-400R to BTX82-800R.

QUICK REFERENCE DATA

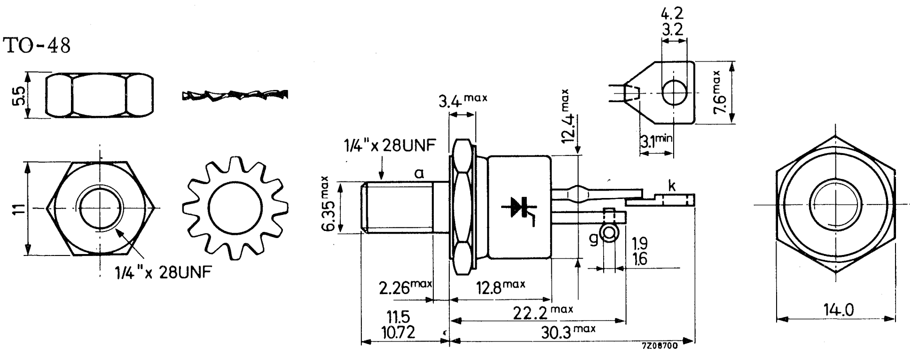
			BTX82 - 400R	500R	600R	700R	800R	
Crest working voltages	$V_{DWM} = V_{RWM}$	max.	400	500	600	700	800	V
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max.	400	500	600	700	800	V

Average on-state current T_{mb} = 85 °C	$I_{T(AV)}$	max.	26	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	40	A
Non-repetitive peak on-state current (t = 10 ms; half sine wave)	I_{TSM}	max.	600	A
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	20	A/µs

MECHANICAL DATA

Dimensions in mm

TO-48



Net weight : 15 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request: 56264A

Torque on nut: min. 17 kg cm
(1.7 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)

All information applies to frequencies up to 400 Hz.

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

ANODE TO CATHODE			BTX82 - 400R	500R	600R	700R	800R	
Voltages 1)								
Continuous reverse voltage	V_R	max.	400	500	600	700	800	V
Crest working voltages 2)	$V_{DWM} = V_{RWM}$	max.	400	500	600	700	800	V
Repetitive peak voltages 2)	$V_{DRM} = V_{RRM}$	max.	400	500	600	700	800	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	500	600	720	850	960	V
Continuous off-state voltage	V_D	max.	400	500	600	700	800	V
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	500	850	850	850	850.	V

Currents

Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 85\ ^oC$	$I_{T(AV)}$	max.	26	A
On-state current (d. c.)	I_T	max.	40	A
R. M. S. on-state current	$I_{T(RMS)}$	max.	40	A
Repetitive peak on-state current	I_{TRM}	max.	350	A
Non-repetitive peak on-state current ($t = 10$ ms; half sine wave) $T_j = 125\ ^oC$ prior to surge	I_{TSM}	max.	600	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	1800	A^2s
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	20	A/µs

1) To ensure thermal stability: $R_{th\ j-a} \leq 3.0\ ^oC/W$ (d. c. blocking) or $\leq 5.5\ ^oC/W$ (a. c.)

2) Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (see page 4) the thyristor may switch into the on-state.

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5.0	V

Current

Forward peak current	I_{FGM}	max.	2.0	A

Power dissipation

Average power dissipation	P_{GAV}	max.	1	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	$R_{th\ j\text{-}mb}$	=	1.0	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^{o}C/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.05	$^{o}C/W$

CHARACTERISTICS

ANODE TO CATHODE

Voltages			BTX82 - 400R	500R	600R	700R	800R	
On-state voltage $I_T = 50$ A; $T_j = 25\ ^oC$	V_T	<	1.4	1.4	1.4	1.4	1.4	V
Forward breakover voltage up to $T_j = 125\ ^oC$	$V_{(BO)}$	>	400	500	600	700	800	V
Currents								
Peak reverse current $V_R = V_{RWM\,max}$; $T_j = 125\ ^oC$	I_{RM}	<	10	8	8	7	6	mA
Peak off-state current $V_D = V_{DWM\,max}$; $T_j = 125\ ^oC$	I_{DM}	<	10	8	8	7	6	mA

Latching current; $T_j = 25\ ^oC$	I_L	<	200	mA
Holding current; $T_j = 25\ ^oC$	I_H	<	100	mA

GATE TO CATHODE

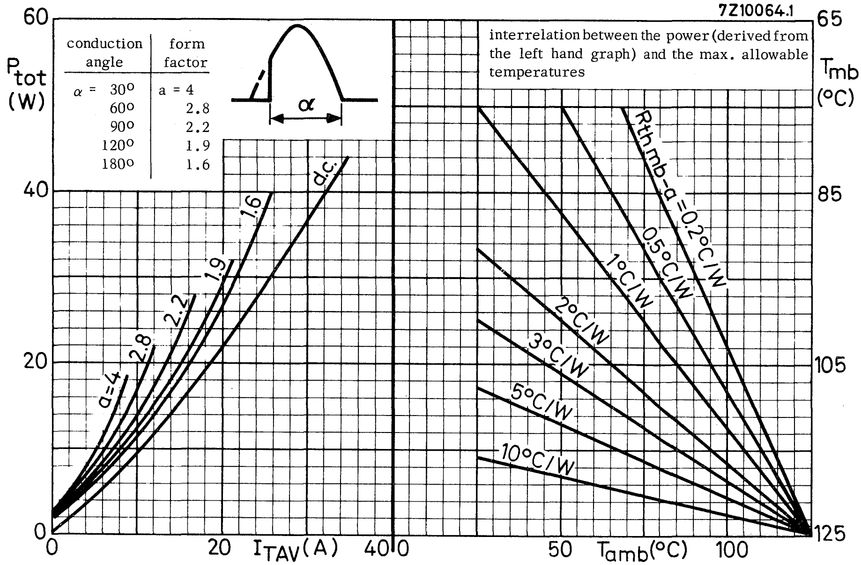
Voltages				
Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25\ ^oC$	V_{GT}	>	3.5	V
Voltage that will not trigger any device $V_D = V_{DRM\,max}$; $T_j = 125\ ^oC$	V_{GD}	<	0.25	V
Current				
Current that will trigger all devices $V_D = 6$ V; $T_j = 25\ ^oC$	I_{GT}	>	80	mA

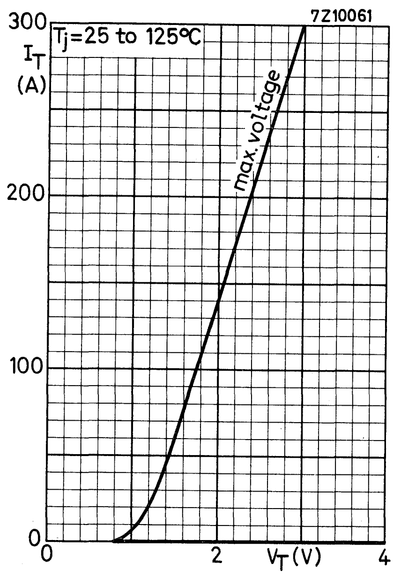
SWITCHING CHARACTERISTICS

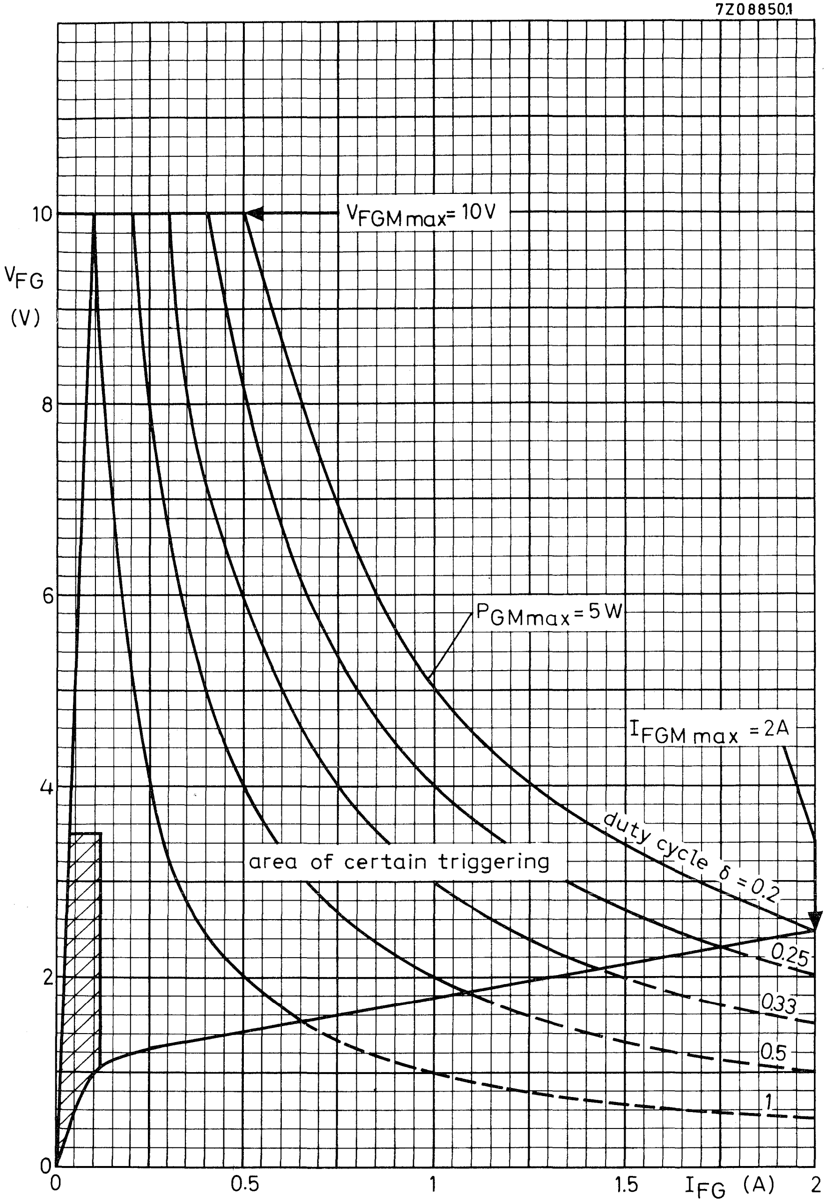
Turn-on time when switched from $V_D = V_{DWM\,max}$ to $I_T = 10$ A; $T_j = 25\ ^oC$	t_{on}	typ.	5	μs
→ Turn-off time when switched from $I_T = 20$ A to $V_R \geq 50$ V with $-dI/dt = 20$ A/μs; $dV_D/dt = 10$ V/μs				
$T_j = 125\ ^oC$	t_q	typ.	250	μs
$T_j = 25\ ^oC$	t_q	<	100	μs

OPERATING NOTES

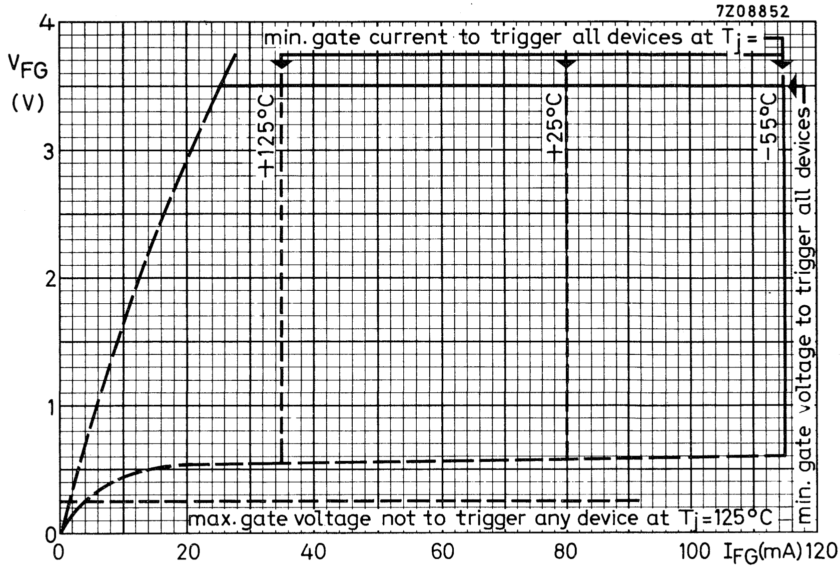
See general pages at the beginning of this section.

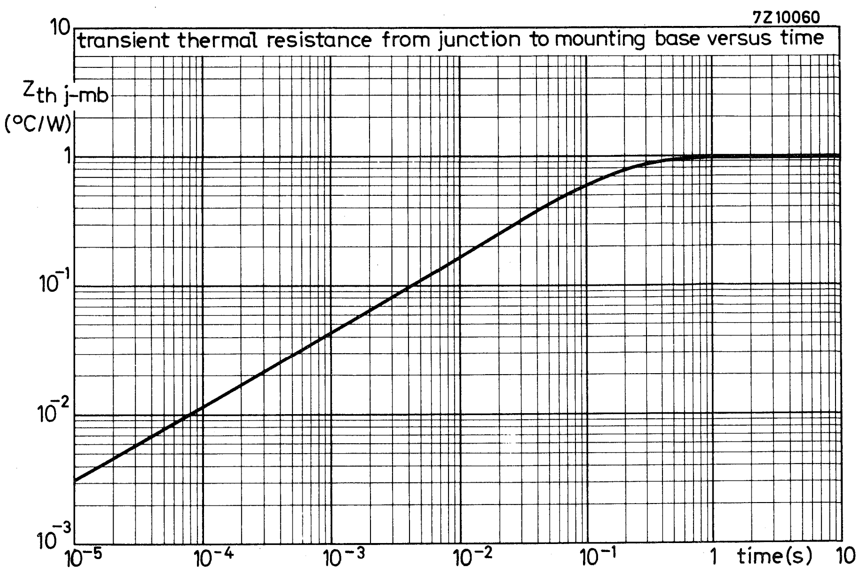

7Z10064.1
conduction angle
form factor
α = 30° a = 4
60° 2.8
90° 2.2
120° 1.9
180° 1.6
α
d.c.
1.6
1.9
2.2
2.8
a=4
P_{tot} (W)
60
40
20
0
0
20
I_{TAV} (A)
40
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
$R_{th\,mb-a}$ = 0.2°C/W
0.5°C/W
1°C/W
2°C/W
3°C/W
5°C/W
10°C/W
0
50
T_{amb} (°C)
100
T_{mb} (°C)
65
85
105
125

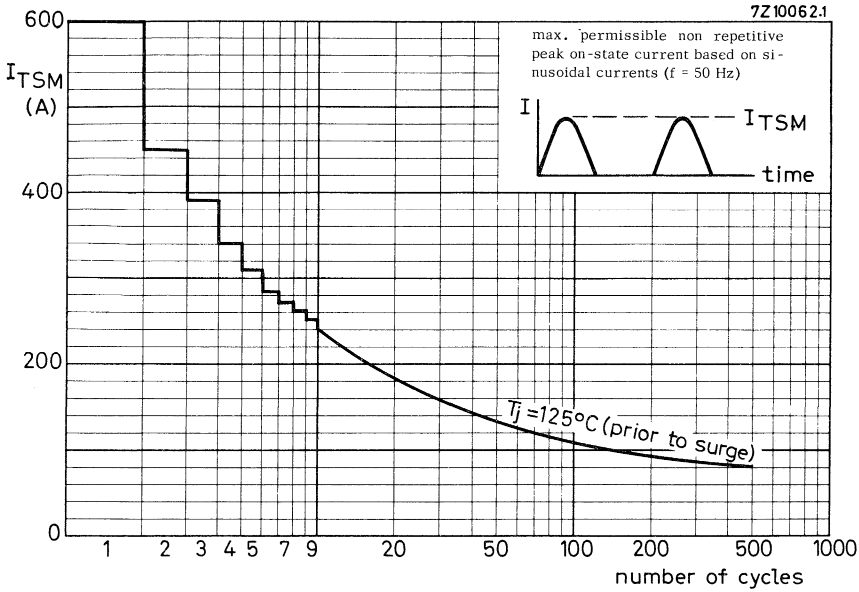

7Z10061
T_j = 25 to 125°C
max. voltage
I_T (A)
300
200
100
0
0
2
V_T (V)
4

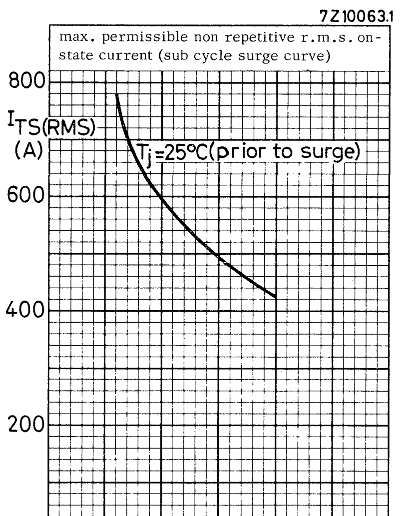


Gate characteristics with curves P_{GAV} = 1 W


7Z08852
min. gate current to trigger all devices at T_j =
+125°C
+25°C
−55°C
min. gate voltage to trigger all devices
max. gate voltage not to trigger any device at T_j = 125°C
V_{FG}
(V)
4
3
2
1
0
0
20
40
60
80
100
I_{FG} (mA)
120


7Z10060
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time(s)
10


7Z10062.1
max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
I
ITSM
time
600
ITSM
(A)
400
200
0
Tj =125°C (prior to surge)
1
2
3
4
5
7
9
20
50
100
200
500
1000
number of cycles


7Z10063.1
max. permissible non repetitive r.m.s. on-state current (sub cycle surge curve)
800
ITS(RMS)
(A)
600
400
200
0
Tj =25°C(prior to surge)
0
5
10
duration(ms)

CONTROLLED AVALANCHE THYRISTORS WITH HIGH dV/dt and dI/dt CAPABILITIES

P-gate silicon thyristors in a TO-48 metal envelope. The devices are designed with high $\frac{dV_D}{dt}$ and $\frac{dI_T}{dt}$ capabilities. They are capable of absorbing transients and intended for power control and power switching applications (motor speed control, furnaces and lighting).
The series consists of reverse polarity types (anode to stud) BTX92-800R to 1200R.

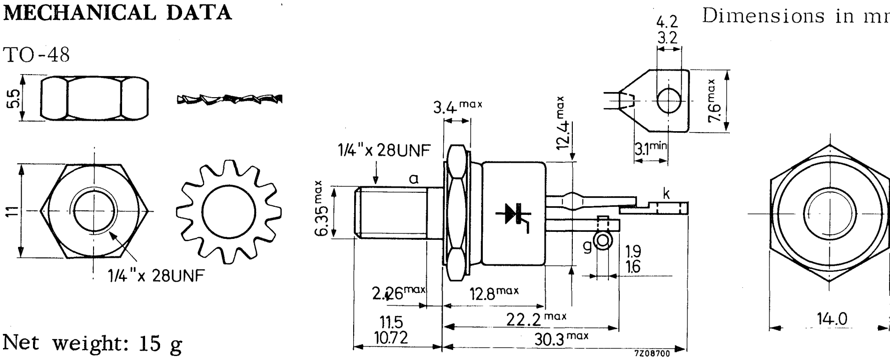
QUICK REFERENCE DATA

			BTX92-800R	1000R	1200R	
Crest working reverse voltage	V_{RWM}	max.	800	1000	1200	V
Crest working off-state voltage	V_{DWM}	max.	800	1000	1200	V
Forward break-over voltage	$V_{(BO)}$	>	900	1100	1300	V
Average forward current at T_{mb} = 85 °C	$I_{T(AV)}$	max.	16	A		
R.M.S. forward current	$I_{T(RMS)}$	max.	25	A		
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	200	A/μs		
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	200	V/μs		

MECHANICAL DATA

Dimensions in mm

TO-48



Net weight: 15 g
Diameter of clearance hole: max. 6.5 mm.
Accessories supplied on request: 56264 A

Torque on nut: min. 17 kg cm
max. 35 kg cm

All information applies to frequencies up to 400 Hz

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

ANODE TO CATHODE

Voltages 1)

			BTX92-800R	1000R	1200R	
Crest working reverse voltage	V_{RWM}	max.	800	1000	1200	V
Crest working off-state voltage	V_{DWM}	max.	800	1000	1200	V 2)

1) To ensure thermal stability: $R_{th\ j\text{-}a}$ 3 °C/W (a.c.).

2) 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

RATINGS (continued)

Currents

Average forward current at T_{mb} = 85 °C	$I_{T(AV)}$	max.	16	A
Forward current (d.c.)	I_T	max.	25	A
R.M.S. forward current	$I_{T(RMS)}$	max.	25	A
Repetitive peak forward current	I_{TRM}	max.	150	A
Non-repetitive peak forward current (half sine-wave) see also page 9	I_{TSM}	max.	280	A
I squared t for fusing ($t \leq 10$ ms)	I^2t	max.	400	A^2s
Rate of rise of forward current after breakover	$\frac{dI_T}{dt}$	max.	100	A/µs
after triggering with $I_G = I_{GT}$	$\frac{dI_T}{dt}$	max.	200	A/µs
Repetitive peak reverse current	I_{RRM}	max.	20	A

Power dissipation

Non-repetitive peak reverse dissipation $t = 10\ \mu s$; $T_j = 25$ °C (see also page 7)	P_{RSM}	max.	10	kW

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	10	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation	$P_{G(AV)}$	max.	1.0	W
Peak power dissipation	P_{GM}	max.	5.0	W

Temperatures

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	**0.06**	°C/W ←

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTX92-800R	1000R	1200R	
Forward voltage I_T = 50 A; T_j = 25 °C	V_T	<	2.7	2.7	2.7	V
Reverse breakdown voltage in the avalanche region	$V_{(BR)R}$	>	900	1100	1300	V
Forward breakover voltage	$V_{(BO)}$	>	900	1100	1300	V
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	200	200	200	V/µs

Currents

Reverse current $V_R = V_{RWMmax}$	I_R	<	10	8	7	mA
Off-state current $V_D = V_{DWMmax}$	I_D	<	10	8	7	mA

Latching current at T_j = 25 °C	I_L	<	200	mA
Holding current at T_j = 25 °C	I_H	<	200	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices T_j = 25 °C	V_{GT}	>	3.5	V
Voltage not to trigger any device	V_{GD}	<	0.2	V

Current

Current to trigger all devices T_j = 25 °C	I_{GT}	>	150	mA

SWITCHING CHARACTERISTICS

Turn-on time when switched from

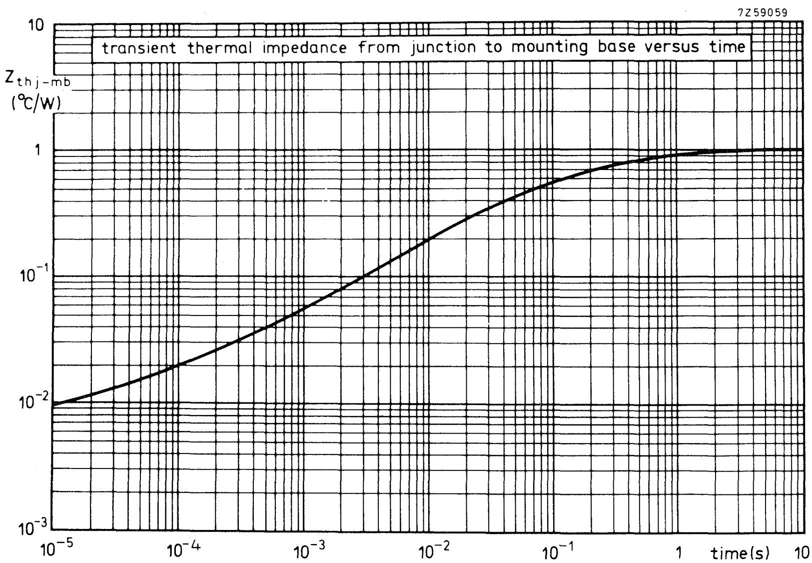
$V_D = V_{DWMmax}$ to I_T = 10 A — t_{on} typ. 2.0 µs

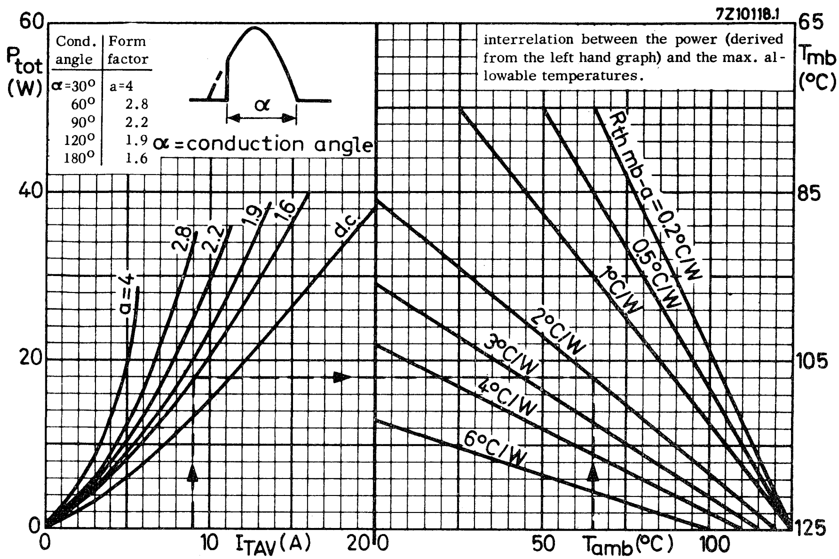
Turn-off time when switched from
I_T = 10 A to $V_R \geq$ 50 V with
$-dI/dt$ = 10 A/µs; dV_D/dt = 10 V/µs

T_j = 125 °C	t_q	typ.	75 µs
		<	250 µs
T_j = 25 °C	t_q	typ.	40 µs
		<	100 µs

OPERATING NOTE (See also general pages at the beginning of this section.)

The gate and cathode connectors should not be bent; they should be soldered into the circuit so that 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.





Determination of the heatsink thermal resistance

Example:

Assume a thyristor, used in a single phase full-wave rectifier circuit.

conduction angle	α	=	180^o	
average forward current	I_{TAV}	=	9	A (per thyristor)
ambient temperature	T_{amb}	=	65	^oC

From the left hand part of the graph above it follows that at I_{TAV} = 9 A and $\alpha = 180^o$ the average forward power + average leakage power = 18 W per thyristor.

From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 18 W at T_{amb} = 65 ^oC

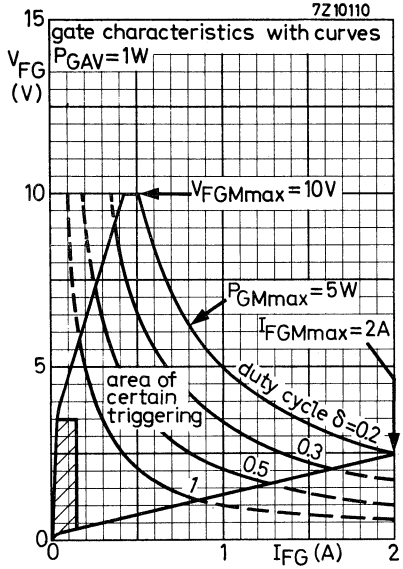
$$R_{th\ mb\text{-}a} \approx 2\ ^oC/W$$

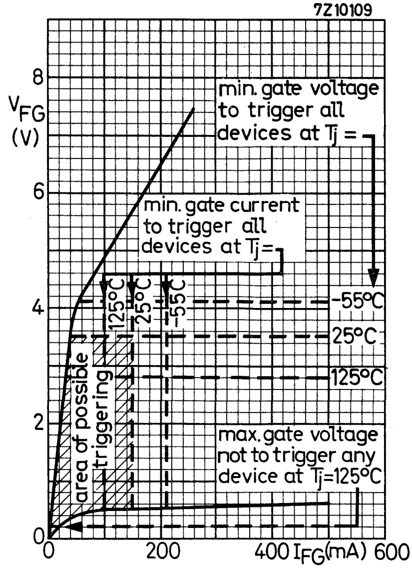
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.2\ ^oC/W$

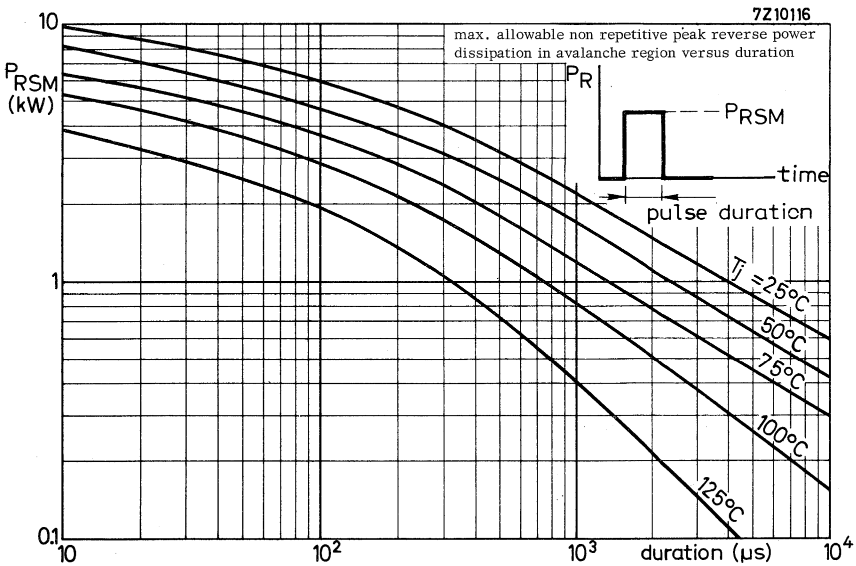
Hence the heatsink thermal resistance should be:

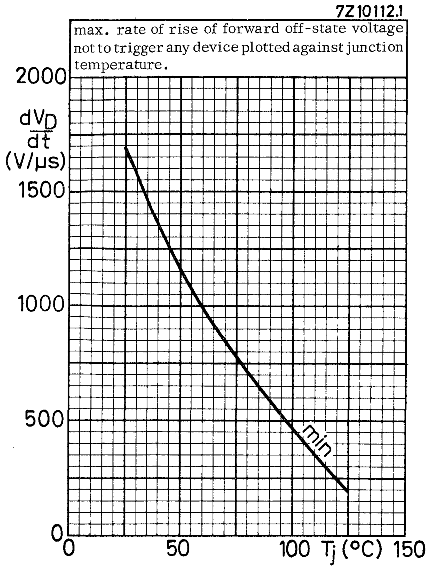
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (2-0.2)\ ^oC/W = 1.8\ ^oC/W$$

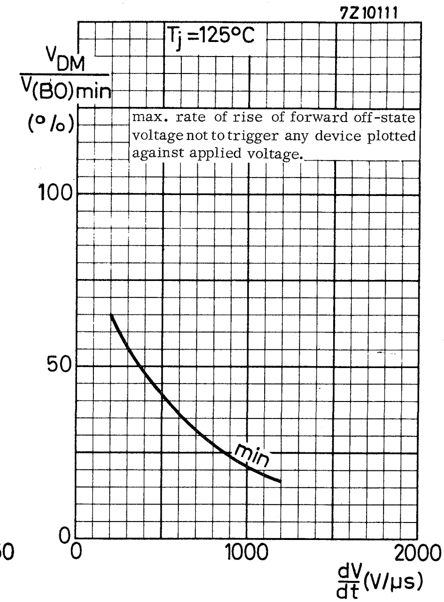
The applicable heatsink(s) may then be found in the Section HEATSINKS.

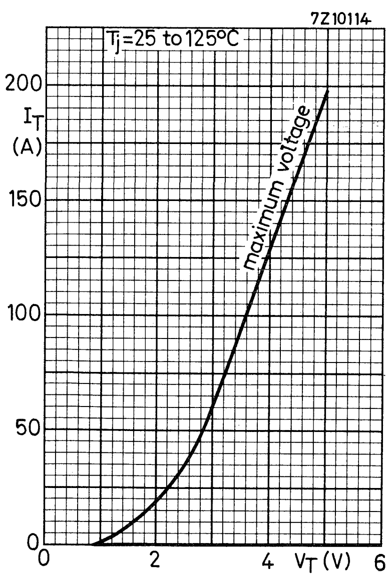

7Z10110
gate characteristics with curves
P_{GAV}=1W
V_{FG} (V)
V_{FGMmax}=10V
P_{GMmax}=5W
I_{FGMmax}=2A
area of certain triggering
duty cycle δ=0.2
0.3
0.5
1
I_{FG} (A)
15
10
5
0
1
2

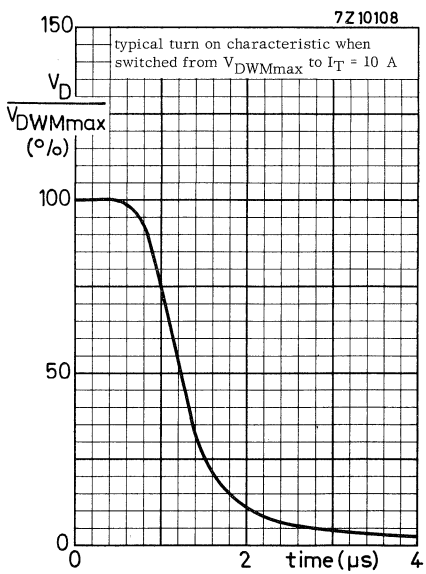

7Z10109
V_{FG} (V)
min. gate voltage to trigger all devices at Tj =
min. gate current to trigger all devices at Tj =
125°C
25°C
-55°C
-55°C
25°C
125°C
area of possible triggering
max. gate voltage not to trigger any device at Tj=125°C
I_{FG} (mA)
0
200
400
600
8
6
4
2

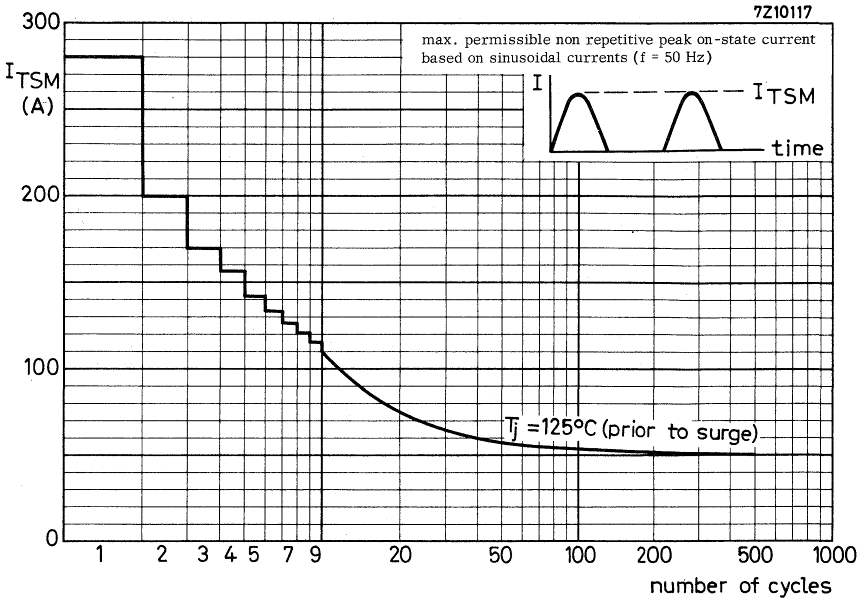

7Z10116
max. allowable non repetitive peak reverse power dissipation in avalanche region versus duration
P_{RSM} (kW)
P_R
P_{RSM}
time
pulse duration
Tj =25°C
50°C
75°C
100°C
125°C
duration (μs)
10
1
0.1
10
10^2
10^3
10^4

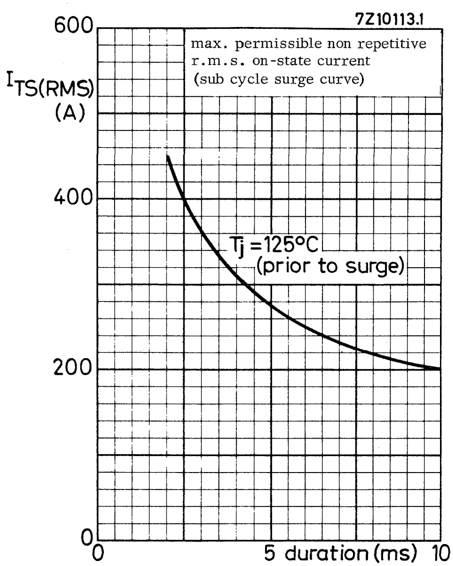

7Z10112.1
max. rate of rise of forward off-state voltage not to trigger any device plotted against junction temperature.
2000
dV_D/dt (V/μs)
1500
1000
500
0
0
50
100
T_j (°C)
150
min

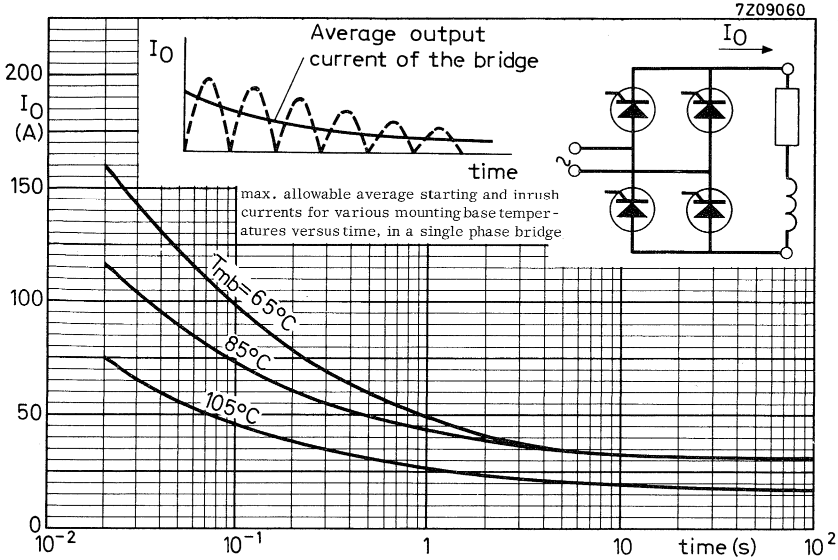

7Z10111
T_j = 125°C
V_DM / V_(BO)min (%)
max. rate of rise of forward off-state voltage not to trigger any device plotted against applied voltage.
100
50
0
0
1000
2000
dV/dt (V/μs)
min

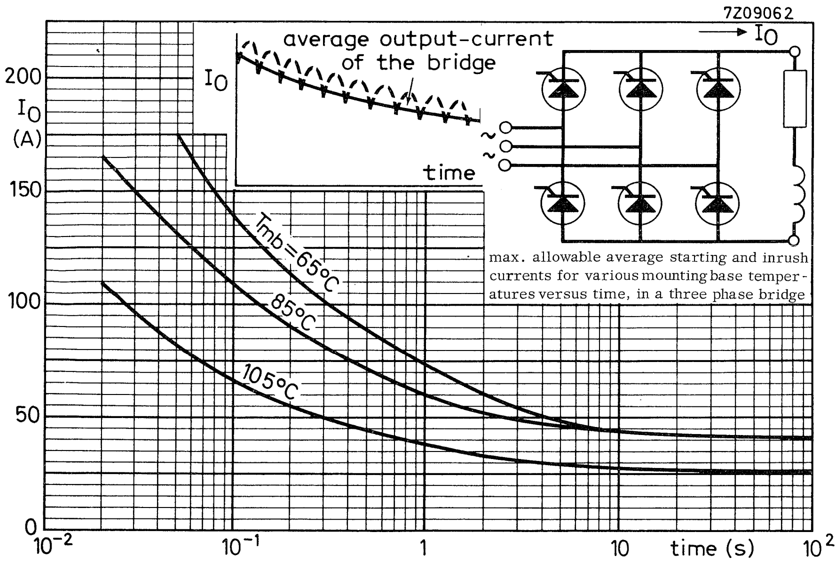

7Z10114
T_j = 25 to 125°C
200
I_T (A)
150
100
50
0
0
2
4
V_T (V)
6
maximum voltage


7Z10108
150
typical turn on characteristic when switched from V_DWMmax to I_T = 10 A
V_D / V_DWMmax (%)
100
50
0
0
2
time (μs)
4


7Z10117
300
I_{TSM}
(A)
200
100
0
1
2
3
4
5
7
9
20
50
100
200
500
1000
number of cycles
max. permissible non repetitive peak on-state current
based on sinusoidal currents (f = 50 Hz)
I
I_{TSM}
time
T_j =125°C (prior to surge)


7Z10113.1
600
$I_{TS(RMS)}$
(A)
400
200
0
0
5
duration (ms)
10
max. permissible non repetitive
r.m.s. on-state current
(sub cycle surge curve)
T_j =125°C
(prior to surge)


7Z09060
I_O
Average output
current of the bridge
time
max. allowable average starting and inrush
currents for various mounting base temper-
atures versus time, in a single phase bridge
200
I_O
(A)
150
100
50
0
10^{-2}
10^{-1}
1
10
time (s)
10^2
T_{mb}=65°C
85°C
105°C


7Z09062
I_O
average output-current
of the bridge
time
max. allowable average starting and inrush
currents for various mounting base temper-
atures versus time, in a three phase bridge
200
I_O
(A)
150
100
50
0
10^{-2}
10^{-1}
1
10
time (s)
10^2
T_{mb}=65°C
85°C
105°C

TRIACS

The BTX94series is a range of bi-directional triode thyristors (triacs), in a TO-48 metal envelope, intended for industrial a.c. power control applications (a.o. furnace temperature control, static switching and motor control).
The series consists of the types BTX94-400 to BTX94-1200

QUICK REFERENCE DATA

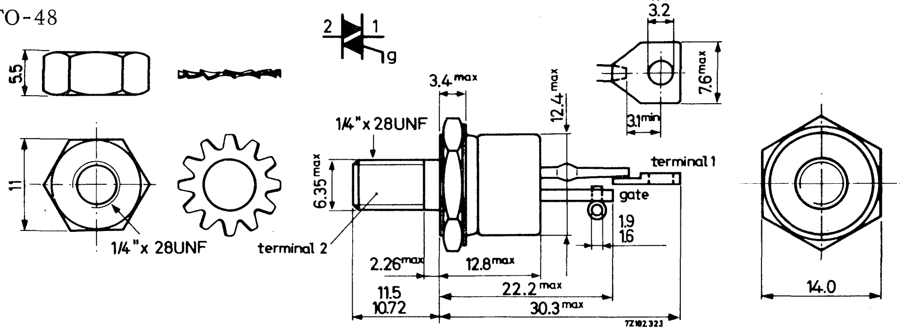
			BTX94 – 400	500	600	700	800	1000	1200	
Crest working voltage	$\pm V_{DWM}$	max.	400	500	600	700	800	1000	1200	V
Repetitive peak off-state voltage	$\pm V_{DRM}$	max.	400	500	600	700	800	1000	1200	V
Breakover voltage	$\pm V_{(BO)}$	>	500	600	700	800	900	1100	1300	V

R.M.S. on-state current at $T_{mb} = 85\ ^{o}C$ (conduction angle 360^{o})	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current at $T_j = 125\ ^{o}C$ prior to surge $t = 20$ ms; full sine wave	$\pm I_{TSM}$	max.	250	A
Junction temperature	T_j	max.	125	^{o}C
Rate of rise of on-state current	$\pm \frac{dI_T}{dt}$	max.	50	A/µs
Rate of rise of off-state voltage that will not trigger any device	$\pm \frac{dV_D}{dt}$	<	100	V/µs
Rate of rise of off-state voltage after commutation	$\pm \frac{dV_D}{dt}$	<	30	V/µs

MECHANICAL DATA

TO-48

Dimensions in mm



Net weight: 15 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request: 56264A

Torque on nut: min. 17 kg cm
(1.7 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)

All information applies to frequencies up to 400 Hz

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

TERMINAL 2 TO TERMINAL 1

Voltages 1)			BTX94 – 400	500	600	700	800	1000	1200	
Crest working voltage	$\pm V_{DWM}$	max.	400	500	600	700	800	1000	1200	V
Repetitive peak off-state voltage	$\pm V_{DRM}$	max.	400	500	600	700	800	1000	1200	V 2)

Currents

R.M.S. on-state current at T_{mb} = 85 °C (conduction angle 360°)	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	$\pm I_{TRM}$	max.	100	A
Non-repetitive peak on-state current at T_j = 125 °C				
t = 10 ms; half sine wave	$\pm I_{TSM}$	max.	250	A
t = 20 ms; full sine wave	$\pm I_{TSM}$	max.	250	A
I squared t for fusing; t = 10 ms	I^2t	max.	312	A^2s
t = 20 ms	I^2t	max.	625	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$; I_{TRM} = 100 A	$\pm\frac{dI_T}{dt}$	max.	50	A/µs

GATE TO TERMINAL 1

Peak voltage (in all modes)	$\pm V_{GM}$	max.	10	V
Peak current (in all modes)	$\pm I_{GM}$	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	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

1) To ensure thermal stability $R_{th\ j\text{-}a} \leq 3.5$ °C/W (a.c.)

2) Higher off-state voltages may be applied without damage, but at voltages higher than the minimum breakover voltage (see page 3) the thyristor may switch into the on-state.

THERMAL RESISTANCE

From junction to mounting base				
full cycle operation	$R_{th\ j\text{-}mb}$	=	1.0	°C/W
half cycle operation	$R_{th\ j\text{-}mb}$	=	2.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal resistance from junction to mounting base (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.12	°C/W

CHARACTERISTICS

TERMINAL 2 TO TERMINAL 1

Voltages

			BTX94 – 400	500	600	700	800	1000	1200	
On-state voltage $\pm I_T$ = 50 A; T_j = 25 °C	$\pm V_T$	<	2.3	2.3	2.3	2.3	2.3	2.3	2.3	V
Breakover voltage	$\pm V_{(BO)}$	>	500	600	700	800	900	1100	1300	V

Rate of rise of off-state voltage that will not trigger any device; T_j = 125 °C $\pm\frac{dV_D}{dt}$ < 100 V/μs

after commutation; $(-\frac{dI_T}{dt} \leq 50$ A/ms); T_j = 125 °C $\pm\frac{dV_D}{dt}$ < 30 V/μs

Current

			BTX94 – 400	500	600	700	800	1000	1200	
Off-state current $\pm V_D = V_{DWMmax}$; T_j = 125 °C	I_D	<	9	9	9	9	9	8	7	mA

SWITCHING CHARACTERISTICS

Turn on time when switched from

$V_D = V_{DWMmax}$ to I_T = 10 A
$I_G = I_{GT}$; T_j = 25 °C $\qquad t_{on}$ typ. 1.5 μs

GATE TO TERMINAL 1

Voltage

Voltage to trigger all devices
terminal 2 positive with respect to 1:

gate positive with respect to terminal 1	V_{GT}	>	3.0	V
gate negative with respect to terminal 1	V_{GT}	>	3.0	V

terminal 2 negative with respect to 1:

gate positive with respect to terminal 1	V_{GT}	>	5.0	V
gate negative with respect to terminal 1	V_{GT}	>	3.0	V

→ Current

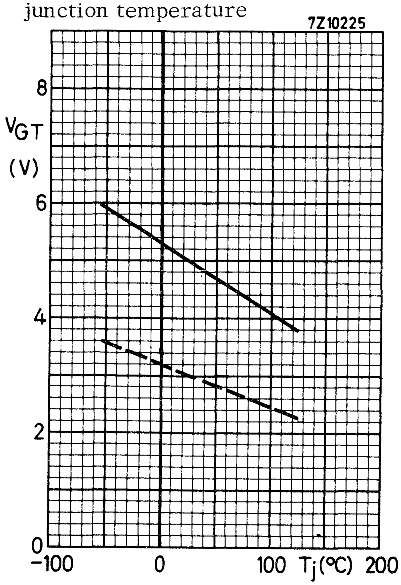
Current to trigger all devices
terminal 2 positive with respect to 1:

gate positive with respect to terminal 1	I_{GT}	>	150	mA
gate negative with respect to terminal 1	$-I_{GT}$	>	150	mA

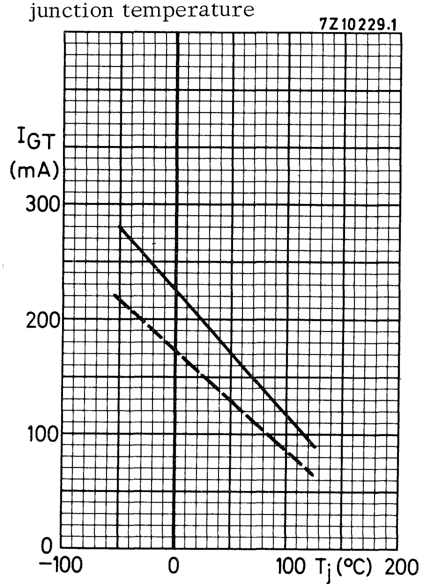
terminal 2 negative with respect to 1:

gate positive with respect to terminal 1	I_{GT}	>	200	mA
gate negative with respect to terminal 1	$-I_{GT}$	>	150	mA

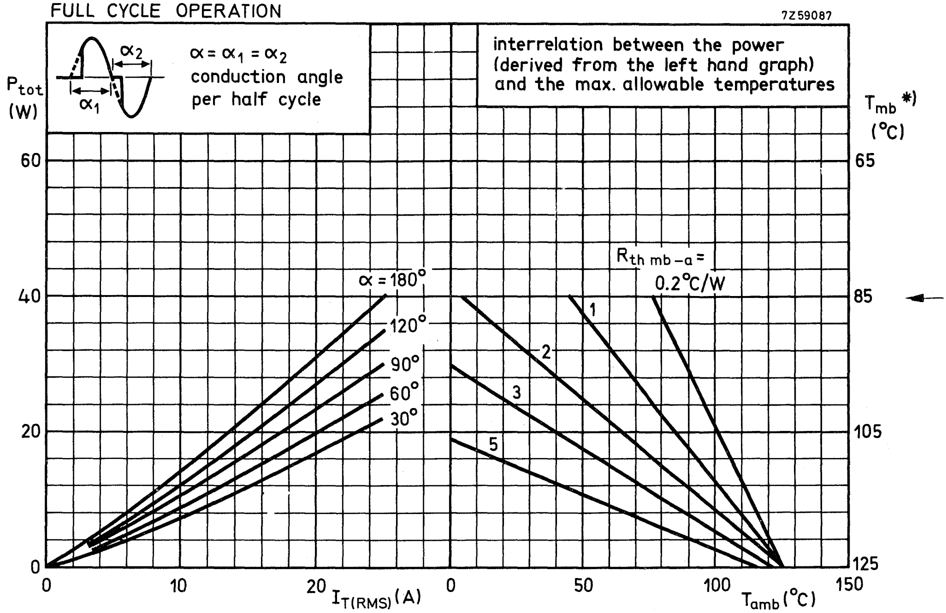
minimum trigger voltage versus junction temperature



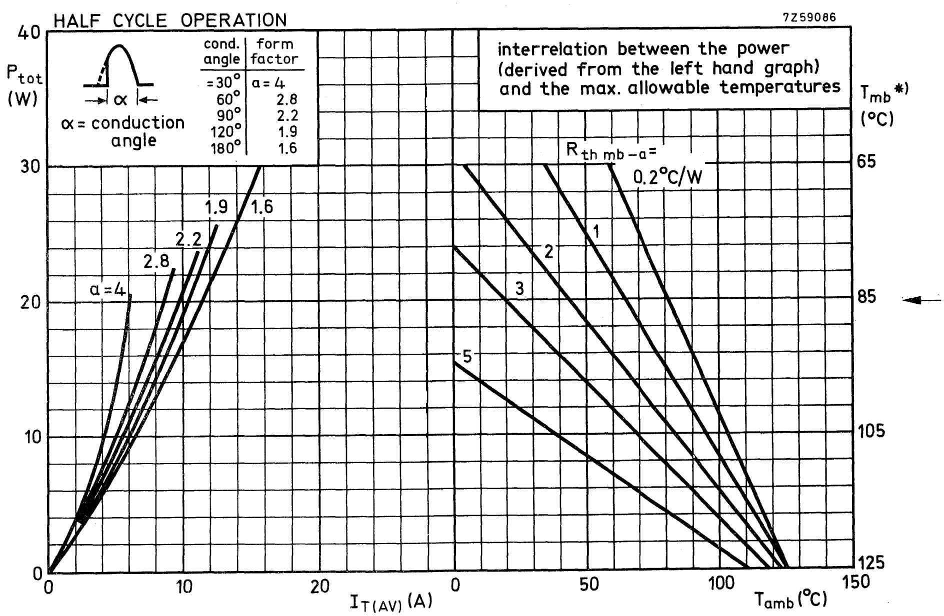
minimum trigger current versus junction temperature



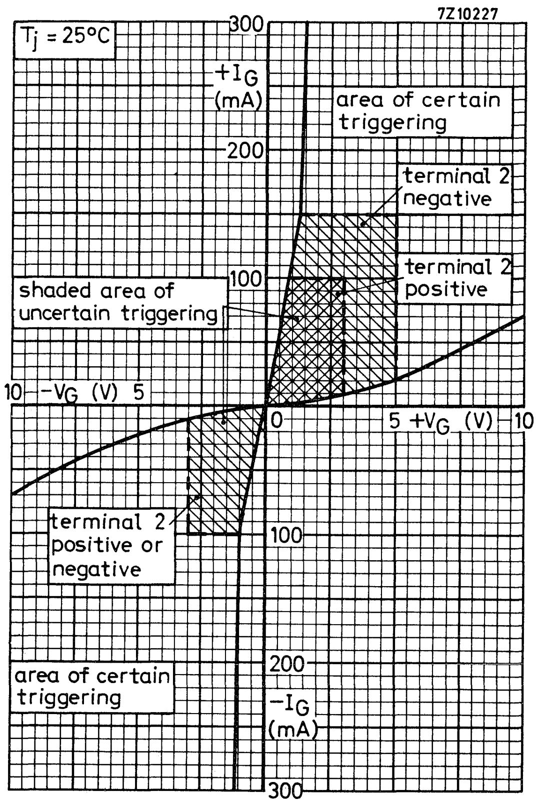
—— terminal 2 negative with respect to 1; gate positive with respect to terminal 1.
---- all other conditions.



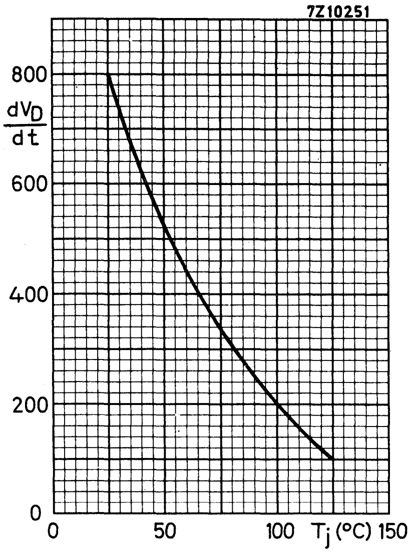
*) T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2.5\ ^{\circ}C/W$

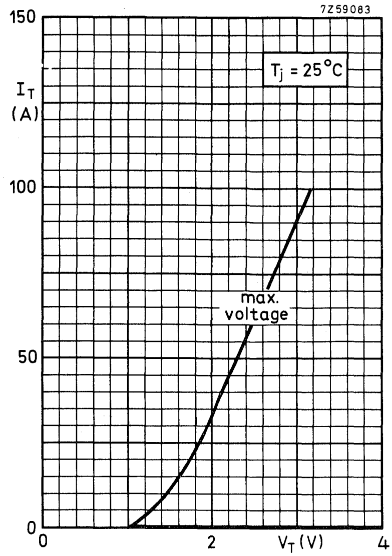


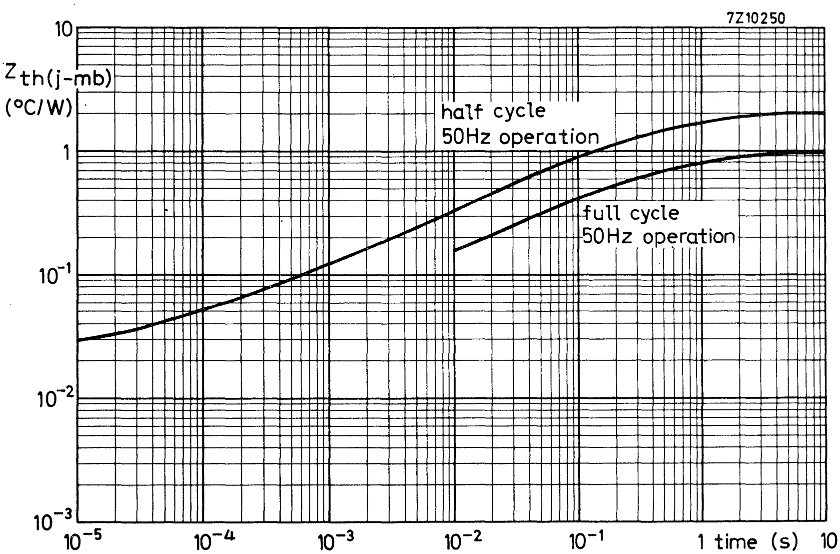
*) T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.5\ ^{\circ}C/W$

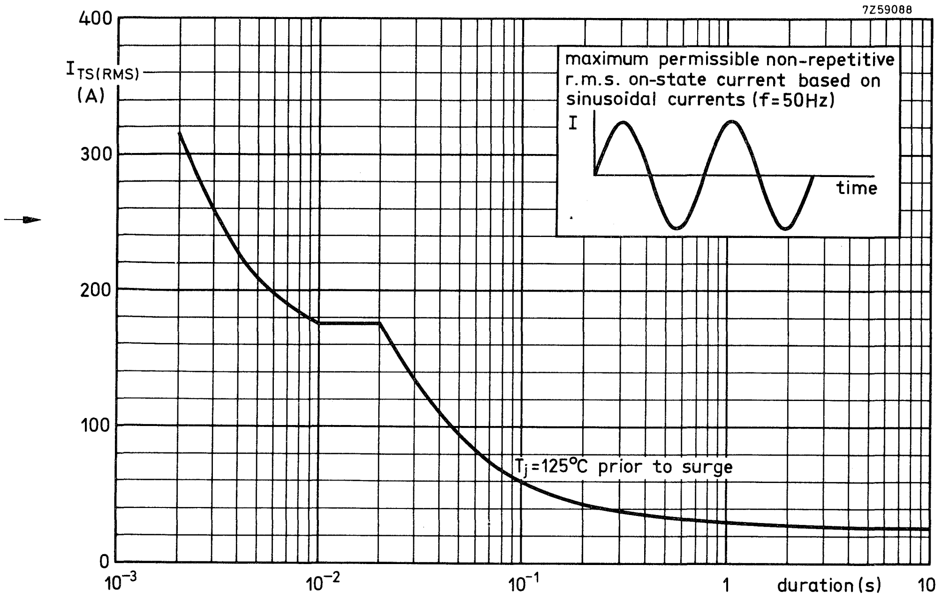

7Z10227
T_j = 25°C
300
+I_G
(mA)
200
100
area of certain
triggering
terminal 2
negative
terminal 2
positive
shaded area of
uncertain triggering
10 −V_G (V) 5
0
5 +V_G (V) 10
terminal 2
positive or
negative
100
200
−I_G
(mA)
300
area of certain
triggering

max. rate of rise of off-state voltage
that will not trigger any device.
(non-commutated condition)








7Z59088
400
300
200
100
0
$I_{TS(RMS)}$
(A)
maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f=50Hz)
I
time
T_j=125°C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

P-GATE SILICON THYRISTORS

P-gate thyristors in a TO-64 metal envelope. They are intended for power control and power switching applications.
The series consists of reverse polarity types (anode to stud) BTY79-400R to BTY79-1000R.

QUICK REFERENCE DATA

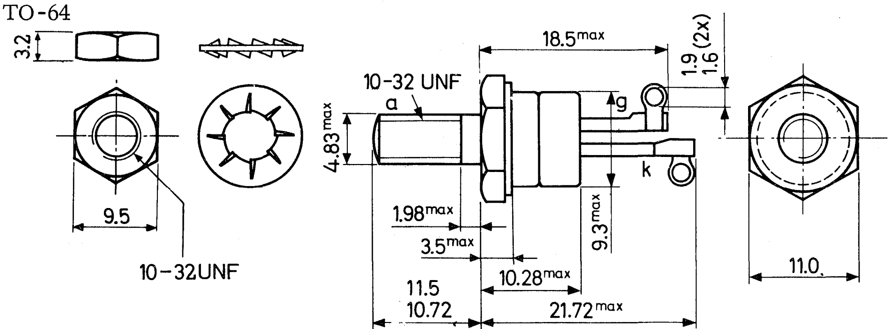
	BTY79 -	400R	500R	600R	700R	800R	1000R	
Crest working reverse voltage	V_{RWM} max.	400	500	600	700	800	1000	V
Crest working off-state voltage	V_{DWM} max.	400	500	600	700	800	1000	V

Average forward current	I_{TAV}	max.	6.4	A
Non repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	80	A
Junction temperature	T_j	max.	125	^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0	$^oC/W$

MECHANICAL DATA

Dimensions in mm

TO-64



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
Accessories available : 56295 (56262A)

All information applies to frequencies up to 400 Hz.

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]

		BTY79- 400R	500R	600R	700R	800R	1000R	
V_R	max.	400	500	600	700	800	1000	V
V_{RWM}	max.	400	500	600	700	800	1000	V
V_{RRM}	max.	400	500	600	700	800	1000	V
V_{RSM} [3]	max.	500	600	720	850	960	1100	V
V_D	max.	400	500	600	700	800	1000	V
V_{DWM}	max.	400	500	600	700	800	1000	V
V_{DRM}	max.	400	500	600	700	800	1000	V
V_{DSM}	max.	500	1100	1100	1100	1100	1100	V [4]

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
R.M.S. forward current	$I_{T(RMS)}$	max.	10	A
Repetitive peak forward current	I_{TRM}	max.	60	A
Non repetitive peak forward current ($t = 10$ ms) See page 10	I_{TSM}	max.	80	A
I squared t for fusing ($t \leq 10$ ms)	I^2t	max.	32	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/μs
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: $R_{th\ j\text{-}a} \leqq 6$ $^oC/W$ (d.c.) or $\leqq 12$ $^oC/W$ (a.c.).

[3] $t < 5$ ms.

[4] 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.

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	$R_{th\ j\text{-}mb}$	=	3.0	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	$^oC/W$
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	4.0	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.16	$^oC/W$

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages	BTY79		400R	500R	600R	700R	800R	1000R
I_T = 20 A [1]) T_j = 25 °C	V_T	<	2.3	2.3	2.3	2.3	2.3	2.3 V
	$V_{(BO)}$	>	400	500	600	700	800	1000 V
not to trigger the device	$\frac{dV_D}{dt}$	typ.	100	100	100	100	100	100 V/μs
not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	20	20 V/μs
Currents								
V_R = V_{RWMmax}. [2])	I_R	<	5	2.5	2.5	2.5	2.5	2.5 mA
V_D = V_{DWMmax}.	I_D	<	5	2.5	2.5	2.5	2.5	2.5 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

SWITCHING CHARACTERISTICS

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 ton typ. 3.0 μs

→ Turn-off time when switched from
I_T = 5 A to V_R ≥ 50 V

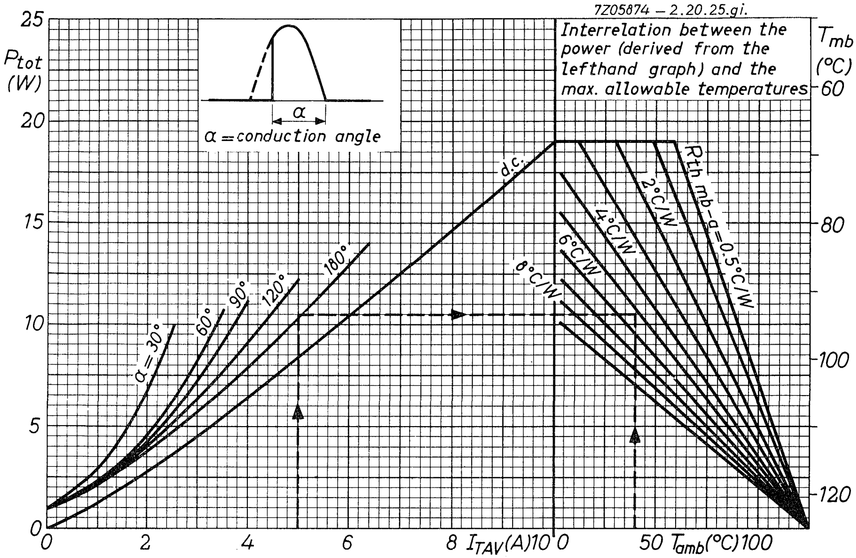
-dI/dt = 5A/μs; dV_D/dt = 10 V/μs
T_j = 125 °C t_q < 100 μs
T_j = 25 °C t_q < 50 μs

1) Measured under pulsed conditions to avoid excessive dissipation.

2) These I_R values apply to a gate voltage range of −5 to +0.25 V.

OPERATING NOTE (See also general pages at the beginning of this section)

The gate and cathode connectors should not be bent or twisted; they should be soldered into the circuit so that 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.



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} = 5 A.

From the left hand part of the graph above it follows that at I_{TAV} = 5 A and α = 180° 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 °C.

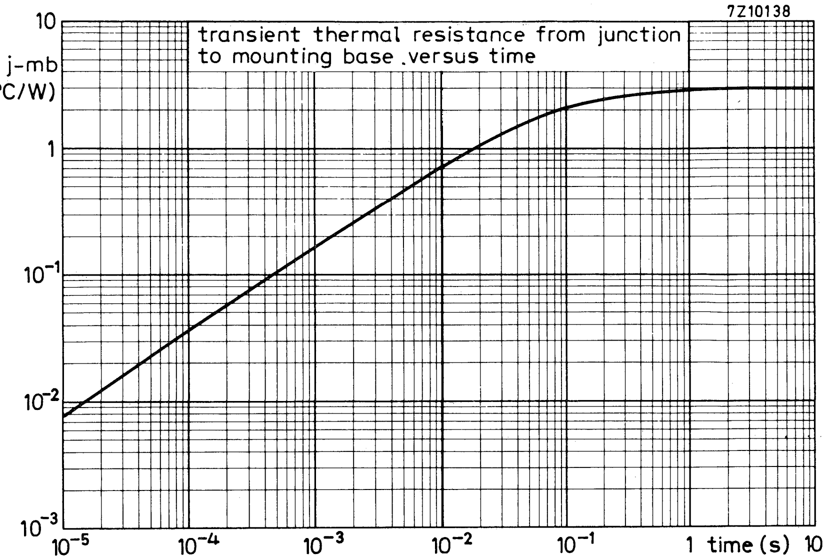
$$R_{th\ mb\text{-}a} \approx 5.2\ ^{\circ}C/W$$

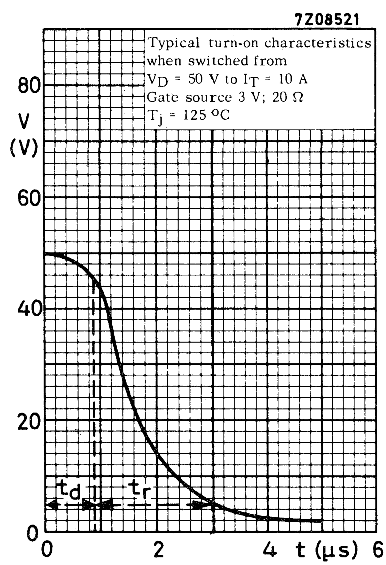
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.5 °C/W

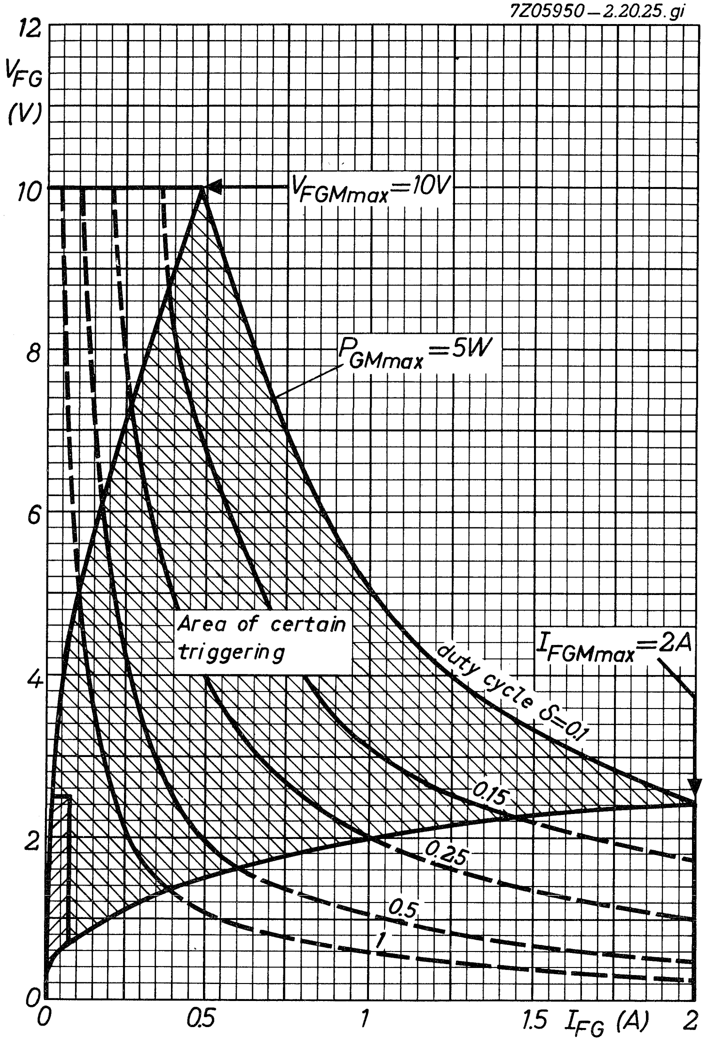
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (5.2 - 0.5)\ ^{\circ}C/W = 4.7\ ^{\circ}C/W$$

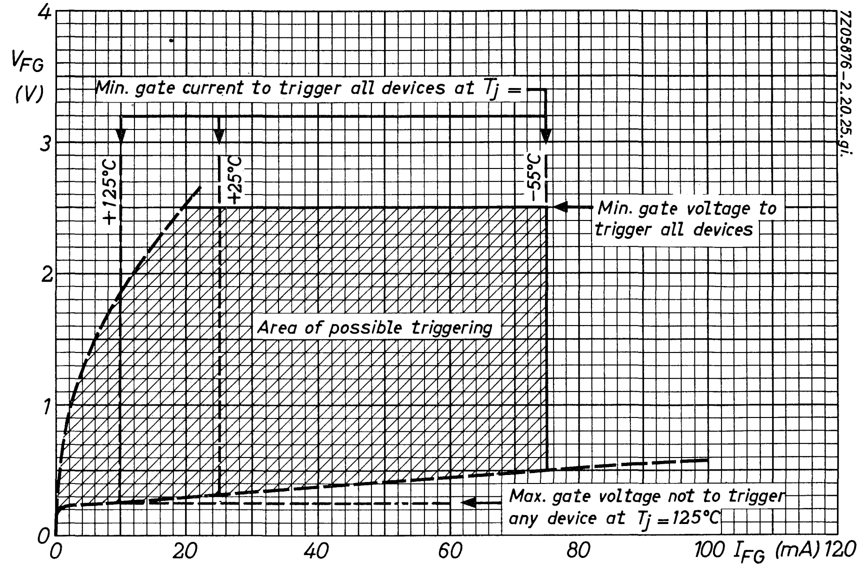
The applicable heatsink(s) may then be found in the section HEATSINKS.

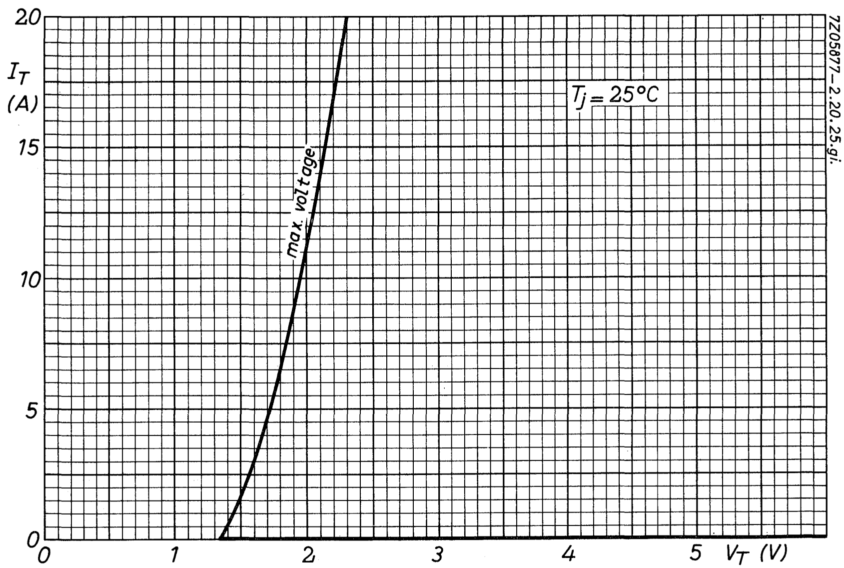

7Z10138
transient thermal resistance from junction to mounting base versus time
Zth j-mb (°C/W)
10
1
10⁻¹
10⁻²
10⁻³
10⁻⁵
10⁻⁴
10⁻³
10⁻²
10⁻¹
1
time (s)
10

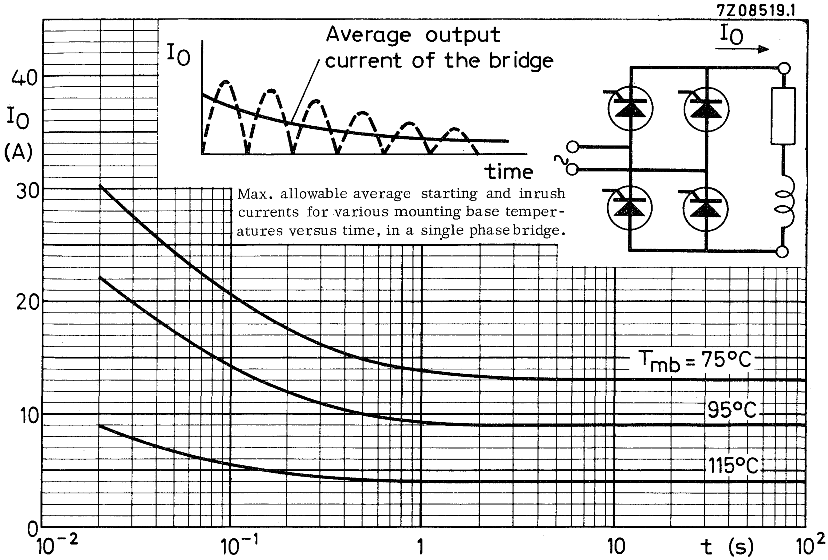

7Z08521
Typical turn-on characteristics when switched from VD = 50 V to IT = 10 A
Gate source 3 V; 20 Ω
Tj = 125 °C
V (V)
80
60
40
20
0
td
tr
0
2
4
t (μs)
6

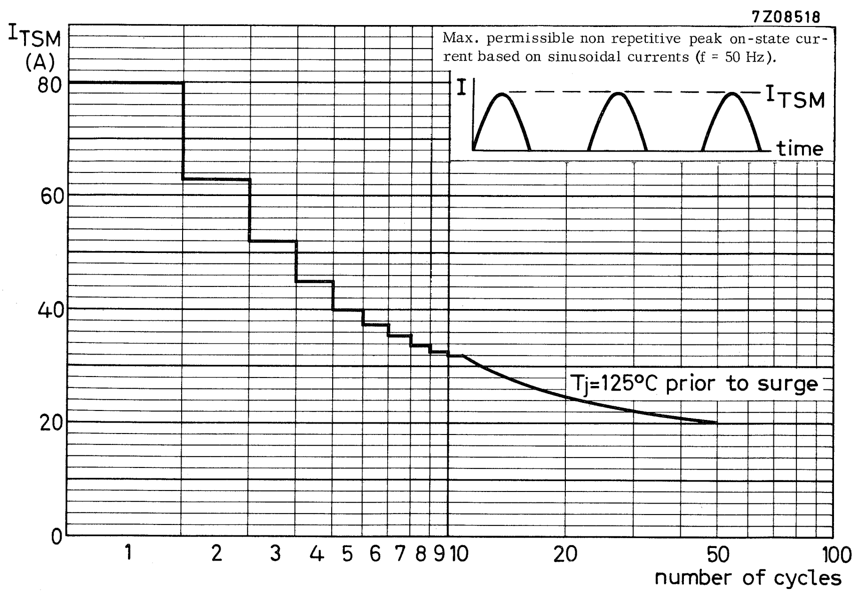


Gate characteristics with curves P_{GAV}=0.5W


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


7Z08519.1
Average output current of the bridge
I_O
time
Max. allowable average starting and inrush currents for various mounting base temperatures versus time, in a single phase bridge.
40
30
20
10
0
I_O (A)
T_{mb} = 75°C
95°C
115°C
10^{-2}
10^{-1}
1
10
t (s)
10^2


7Z08518
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz).
I
I_{TSM}
time
I_{TSM} (A)
80
60
40
20
0
T_j=125°C prior to surge
1
2
3
4
5
6
7
8
9
10
20
50
100
number of cycles

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 reverse polarity types (anode to stud) BTY87-400R to 800R.

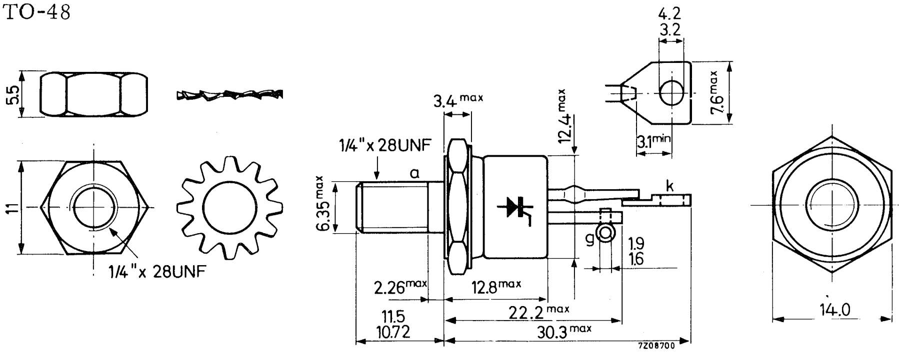
QUICK REFERENCE DATA

		BTY87-	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM}	max.	400	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	400	500	600	700	800	V

Average forward current at T_{mb} = 75 °C	I_{TAV}	max.	12	A
T_{mb} = 85 °C	I_{TAV}	max.	10	A
Non repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	140	A
Junction temperature	T_j	max.	125	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.6	°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

Diameter of hole in heatsink: max. 6.5 mm
Accessories available: 56264A

All information applies to frequencies up to 400 Hz.

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

ANODE TO CATHODE

Voltages 1)

	BTY87-	400R	500R	600R	700R	800R	
Continuous reverse voltage	V_R max.	400	500	600	700	800	V
Crest working reverse voltage	V_{RWM} max.	400	500	600	700	800	V
Repetitive peak reverse voltage	V_{RRM} max.	400	500	600	700	800	V
Non repetitive peak reverse voltage ($t \leq 5$ ms)	V_{RSM} max.	500	600	720	850	960	V
Continuous off-state voltage	V_D max.	400	500	600	700	800	V
Crest working off-state voltage	V_{DWM} max.	400	500	600	700	800	V
Repetitive peak off-state voltage	V_{DRM} max.	400	500	600	700	800	V
Non rep. peak off-state voltage	V_{DSM} max.	500	850	850	850	850	V 2)

Currents

Average forward current (averaged over any 20 ms period) T_{mb} = 75 °C	I_{TAV}	max.	12	A
T_{mb} = 85 °C	I_{TAV}	max.	10	A
Forward current (d.c.)	I_T	max.	19	A
R.M.S. forward current	$I_{T(RMS)}$	max.	19	A
Repetitive peak forward current	I_{TRM}	max.	140	A
Non repetitive peak forward current (t = 10 ms) See page 5	I_{TSM}	max.	140	A
I squared t, for fusing (t = 1.5 to 10 ms)	I^2t	max.	100	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/µs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

1) These ratings apply to a gate voltage range of −5 to +0.20 V
To ensure thermal stability: $R_{th\ j\text{-}a} \leq 4.5$ °C/W (d.c.) or < 9 °C/W (a.c.)

2) 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.

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	$R_{th\ j\text{-}mb}$	=	1.6	$^{o}C/W$
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	$^{o}C/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.09	$^{o}C/W$

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

	BTY87-		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	V [1]
Forward breakover voltage	$V_{(BO)}$	>	400	500	600	700	800	V
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	20	V/μs
Currents								
Reverse current $V_R = V_{RWMmax}$.	I_R	<	8.0	6.0	5.0	4.5	4.0	mA [2]
Off-state current $V_D = V_{DWMmax}$.	I_D	<	8.0	6.0	5.0	4.5	4.0	mA

Latching current	I_L	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}	<	0.20	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 avoid excessive dissipation.

[2]) These I_R values apply to a gate voltage range of −5 to +0.20 V.

SWITCHING CHARACTERISTICS

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 $V_R \geq 50$ V

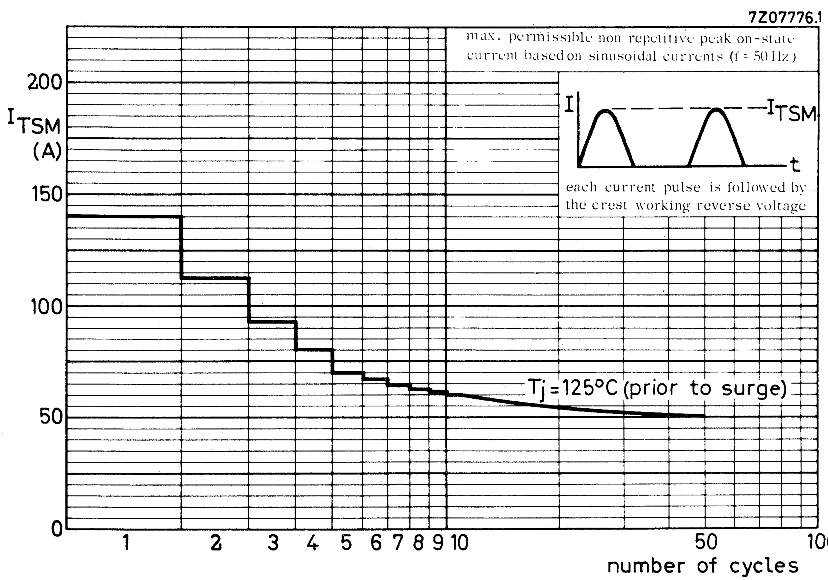
with -dI/dt = 10 A/μs; dV_D/dt = 10 V/μs

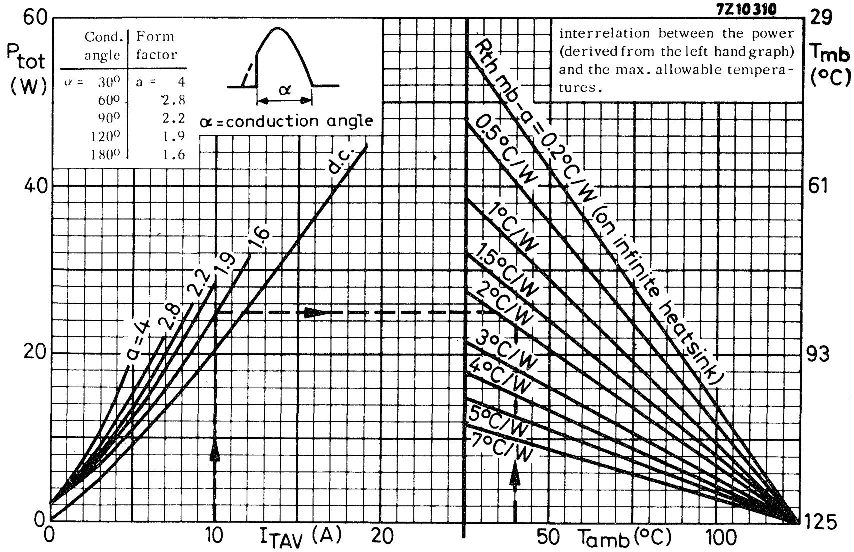
T_j = 125 °C	t_q	<	100	μs
T_j = 25 °C	t_q	<	50	μs

OPERATING NOTES

See general pages at the beginning of this section.

The gate and cathode connectors should not be bent; they should be soldered into the circuit so that 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.





Determination of the heatsink thermal resistance

Example:
Assume a thyristor, used in a single phase full wave rectifier circuit.

conduction angle	α	=	180°
average forward current	I_{TAV}	=	10 A (per thyristor)
ambient temperature	T_{amb}	=	40 °C

From the left hand part of the graph above it follows that at I_{TAV} = 10 A and α = 180° the average forward power + average leakage power = 25 W per thyristor.

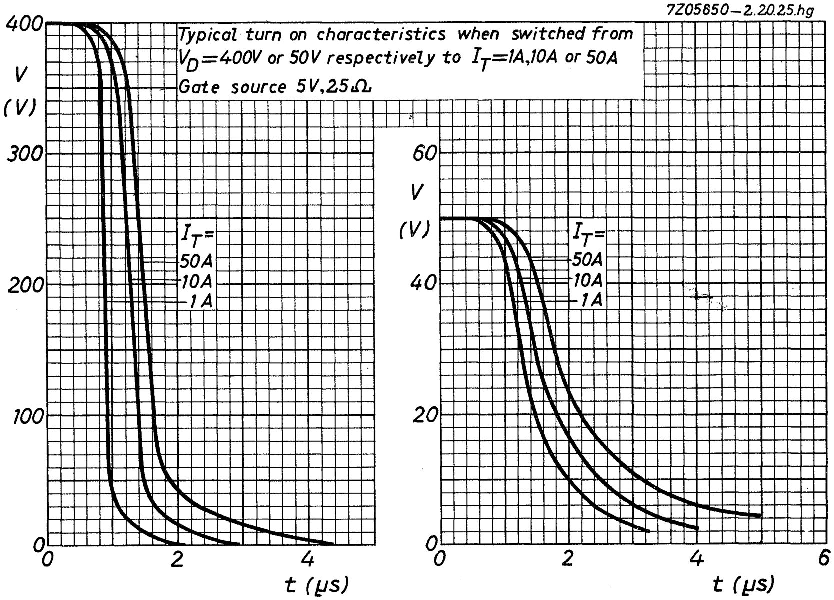
From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 25 W at T_{amb} = 40 °C

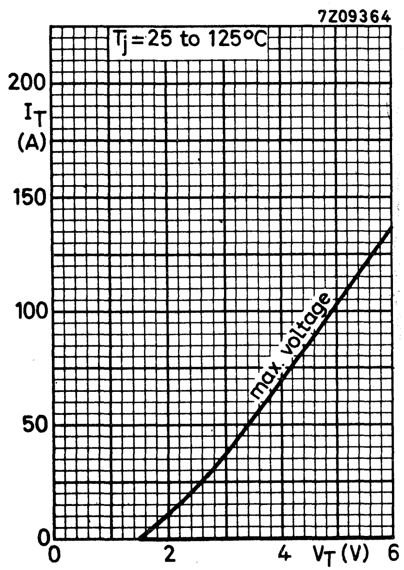
$$R_{th\ mb\text{-}a} \approx 1.8\ ^{o}C/W$$

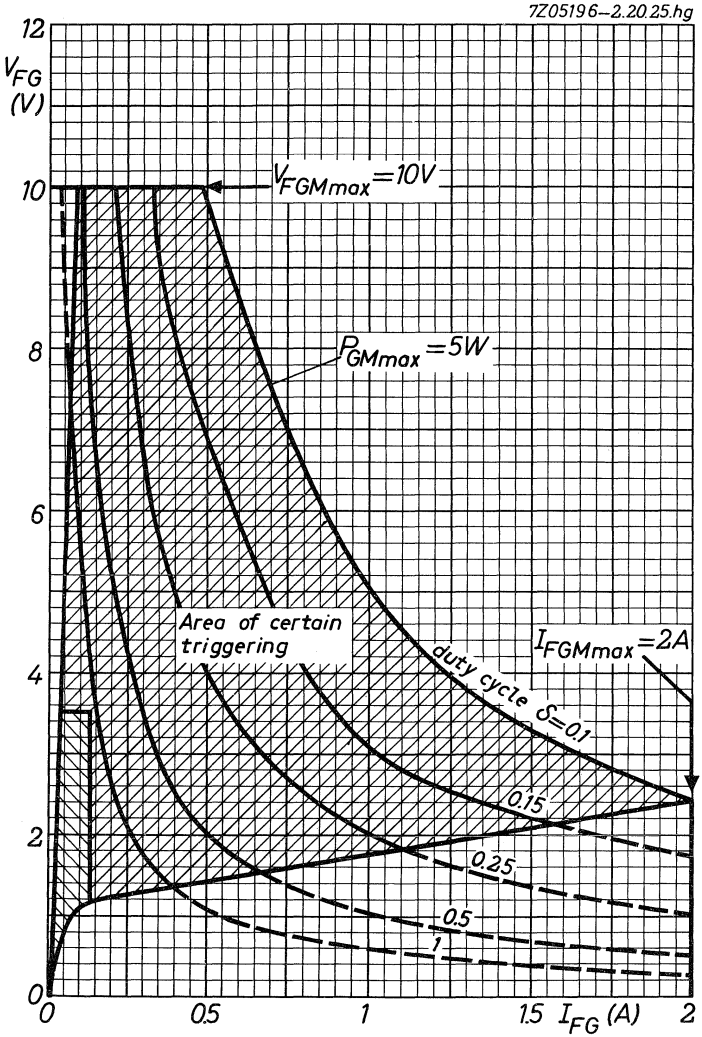
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.2 °C/W.
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (1.8 - 0.2)\ ^{o}C/W = 1.6\ ^{o}C/W.$$

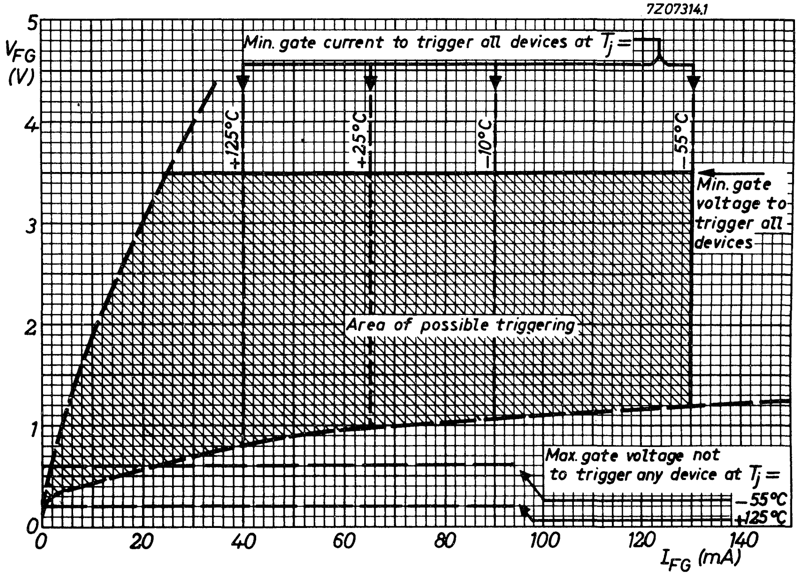
The appropriate heatsink(s) will be found in the Section HEATSINKS.

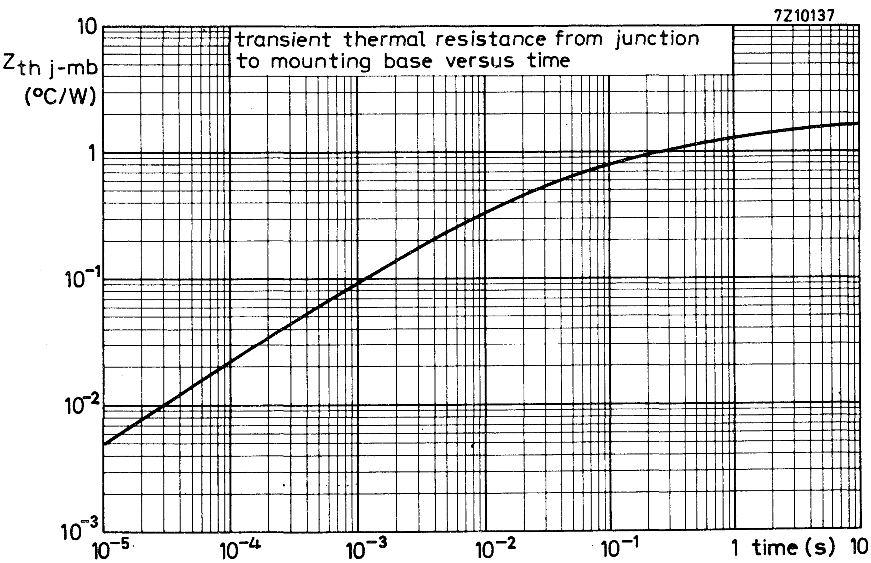

7Z05850−2.20.25.hg
Typical turn on characteristics when switched from
V_D=400V or 50V respectively to I_T=1A,10A or 50A
Gate source 5V,25Ω
400
V
(V)
300
200
100
0
I_T=
50A
10A
1A
0
2
4
t (μs)
60
V
(V)
40
20
0
I_T=
50A
10A
1A
0
2
4
6
t (μs)


7Z09364
T_j=25 to 125°C
200
I_T
(A)
150
100
50
0
max. voltage
0
2
4
V_T (V)
6

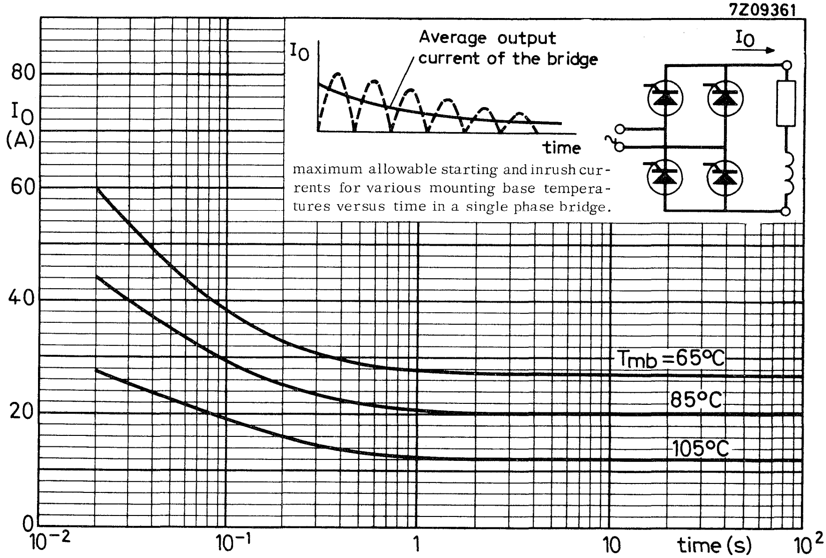


Gate characteristics with curves $P_{GAV}=0.5W$

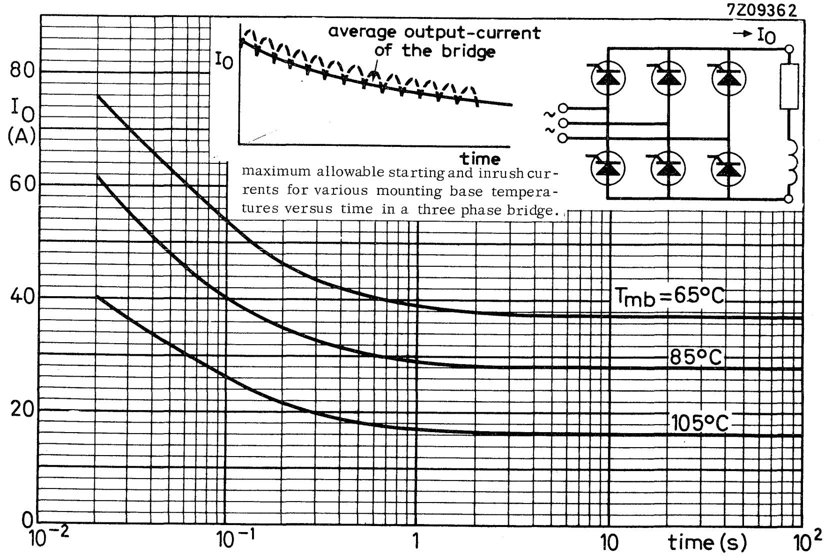

7Z07314.1
V_{FG} (V)
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j =
−55°C
+125°C
I_{FG} (mA)


7Z10137
$Z_{th\ j\text{-}mb}$ (°C/W)
transient thermal resistance from junction to mounting base versus time
time (s)

7Z09361



7Z09362



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 reverse polarity types (anode to stud) BTY91-400R to 800R.

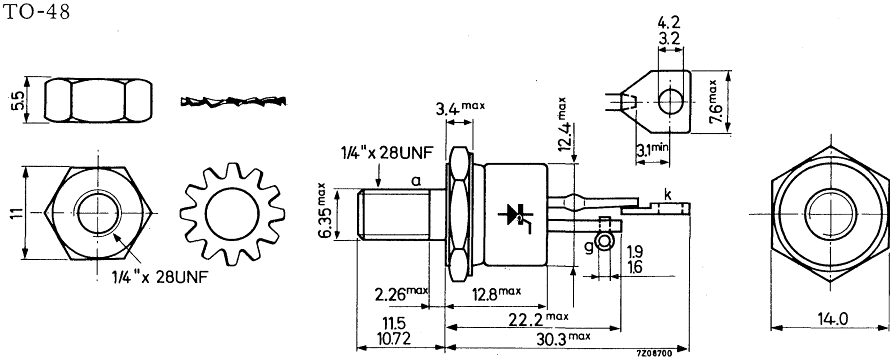
QUICK REFERENCE DATA

	BTY91-	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	400	500	600	700	800	V
Crest working off-state voltage	V_{DWM} max.	400	500	600	700	800	V

Average forward current at T_{mb} = 77 °C	I_{TAV}	max.	16	A
T_{mb} = 85 °C	I_{TAV}	max.	14	A
Non repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	200	A
Junction temperature	T_j	max.	125	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.6	°C/W

MECHANICAL DATA Dimensions in mm

TO-48



Net weight: : 10 g
With accessories: 15 g
Diameter of hole in heatsink: max. 6.5 mm
Accessories available: 56264A

Torque on nut: min. 17 cm kg
max. 35 cm kg

All information applies to frequencies up to 400 Hz.

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

ANODE TO CATHODE

Voltages 1)		BTY91- 400R	500R	600R	700R	800R	
Continuous reverse voltage	V_R max.	400	500	600	700	800	V
Crest working reverse voltage	V_{RWM} max.	400	500	600	700	800	V
Repetitive peak reverse voltage	V_{RRM} max.	400	500	600	700	800	V
Non repetitive peak reverse voltage ($t < 5$ ms)	V_{RSM} max.	500	600	720	850	960	V
Continuous off-state voltage	V_D max.	400	500	600	700	800	V
Crest working off-state voltage	V_{DWM} max.	400	500	600	700	800	V
Repetitive peak off-state voltage	V_{DRM} max.	400	500	600	700	800	V
Non rep. peak off-state voltage	V_{DSM} max.	500	850	850	850	850	V 2)

Currents

Average forward current (averaged over any 20 ms period) $T_{mb} = 77$ °C	I_{TAV}	max.	16	A
$T_{mb} = 85$ °C	I_{TAV}	max.	14	A
Forward current (d.c.)	I_T	max.	25	A
R.M.S. forward current	$I_{T(RMS)}$	max.	25	A
Repetitive peak forward current	I_{TRM}	max.	200	A
Non repetitive peak forward current ($t = 10$ ms) See page 5	I_{TSM}	max.	200	A
I squared t, for fusing ($t = 1.5$ to 10 ms)	I^2t	max.	200	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/µs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

1) These ratings apply at a gate voltage range of −5 to +0.20 V
To ensure thermal stability: $R_{th\ j-a} \leq 4.5$ °C/W (d.c.) or ≤ 9 °C/W (a.c.)

2) 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.

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	$R_{th\ j-mb}$	=	1.6	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.2	$^{o}C/W$
From mounting base to heatsink with mica washer	$R_{th\ mb-h}$	=	4.0	$^{o}C/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j-mb}$	=	0.09	$^{o}C/W$

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

	BTY91-		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	V [1]
Forward breakover voltage	$V_{(BO)}$	>	400	500	600	700	800	V
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	20	V/µs
Currents								
Reverse current $V_R = V_{RWMmax.}$	I_R	<	8.0	6.0	5.0	4.5	4.0	mA [2]
Off-state current $V_D = V_{DWMmax.}$	I_D	<	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}	<	0.20	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 avoid excessive dissipation.

2) These I_R values apply to a gate voltage range of −5 to +0.20 V.

SWITCHING CHARACTERISTICS

Turn-on time when switched from

V_D = 400 V to I_T = 50 A

Gate source 5V, 25 Ω; T_j = 125 °C	ton	typ.	2.0	μs

Turn-off time when switched from

I_T = 10 A to $V_R \geq 50$ V

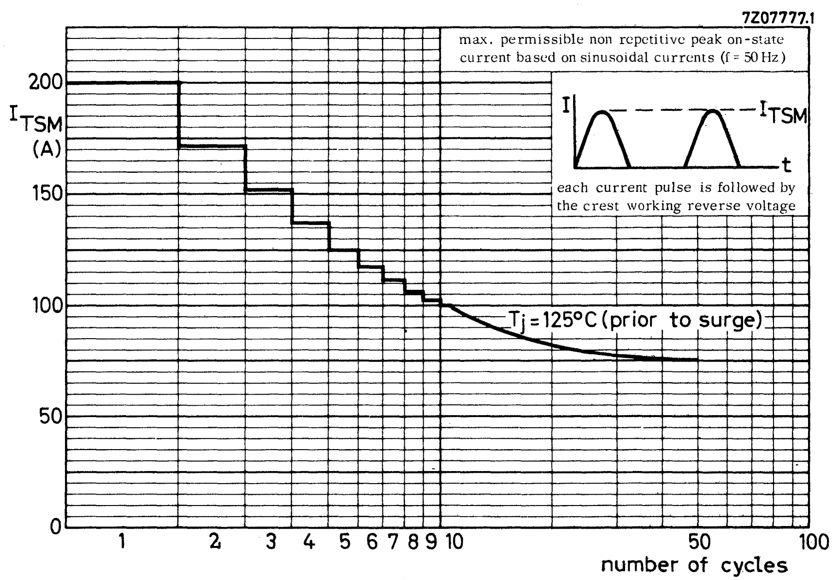
with $-dI/dt$ = 10 A/μs; dV_D/dt = 10 V/μs

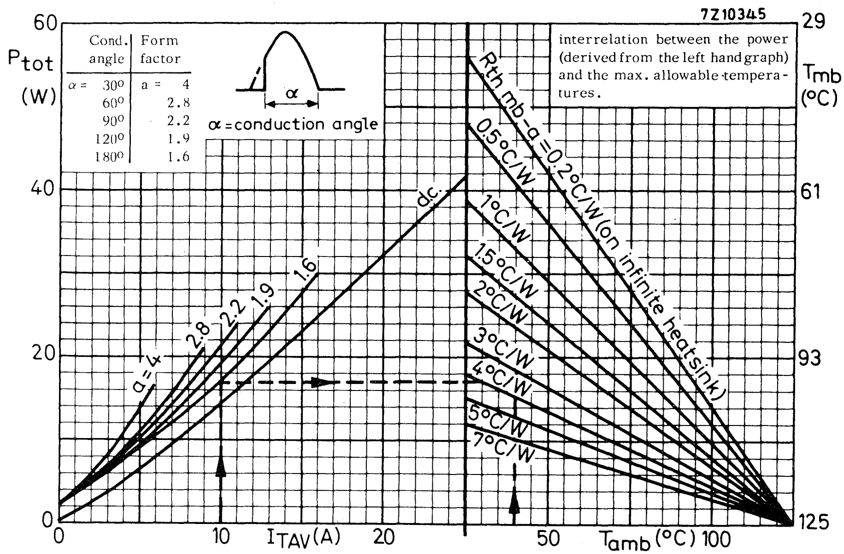
T_j = 125 °C	t_q	<	100	μs
T_j = 25 °C	t_q	<	50	μs

OPERATING NOTES

See general pages at the beginning of this section.

The gate and cathode connectors should not be bent; they should be soldered into the circuit so that 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.





Determination of the heatsink thermal resistance

Example:
Assume a thyristor, used in a single phase full wave rectifier circuit.

conduction angle	α	=	180°	
average forward current	I_{TAV}	=	10	A (per thyristor)
ambient temperature	T_{amb}	=	40	°C

From the left hand part of the graph above it follows that at I_{TAV} = 10 A and α = 180° the average forward power + average leakage power = 17 W per thyristor.

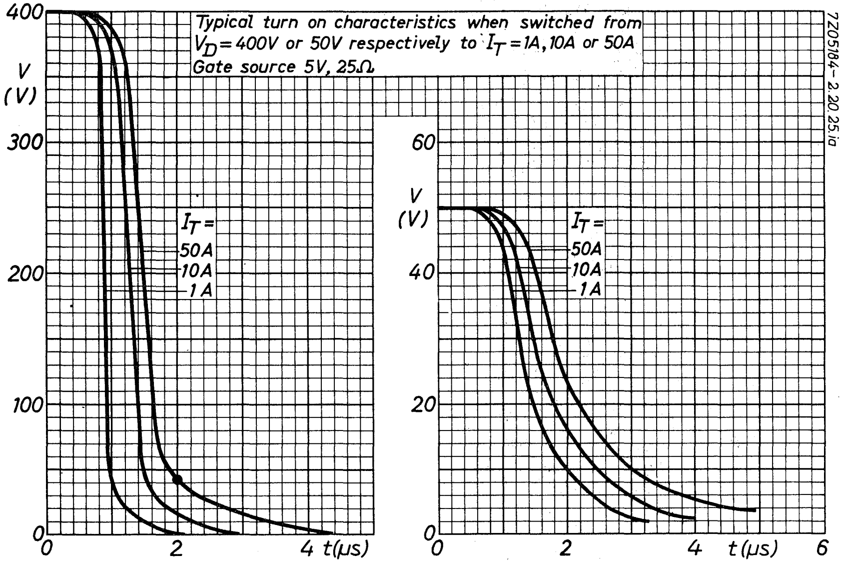
From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 17 W at T_{amb} = 40 °C

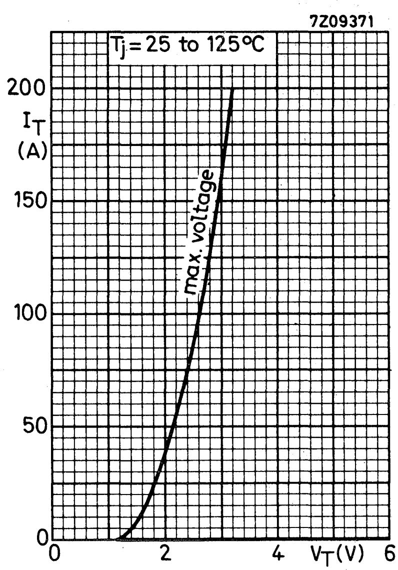
$$R_{th\ mb\text{-}a} \approx 3.5\ ^{\circ}C/W$$

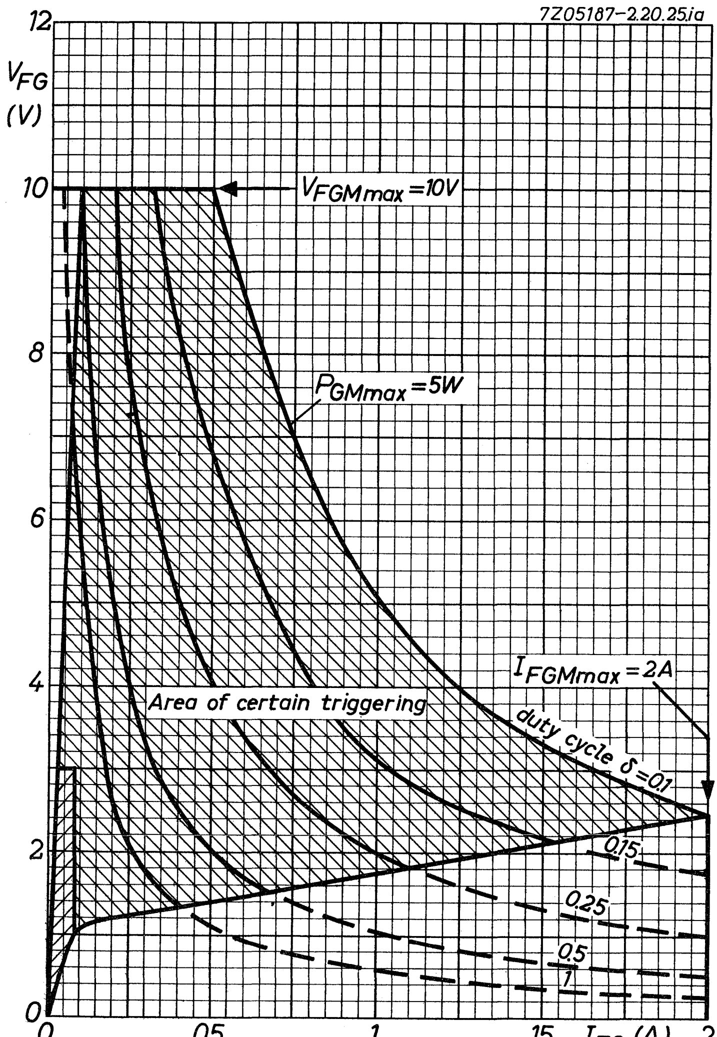
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.2 °C/W.
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (3.5 - 0.2)\ ^{\circ}C/W = 3.3\ ^{\circ}C/W.$$

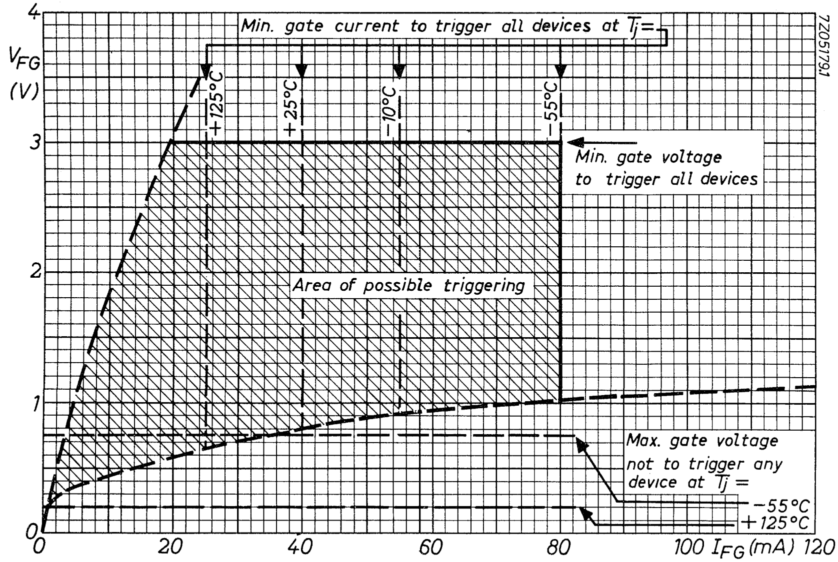
The appropriate heatsink(s) will be found in the Section HEATSINKS.

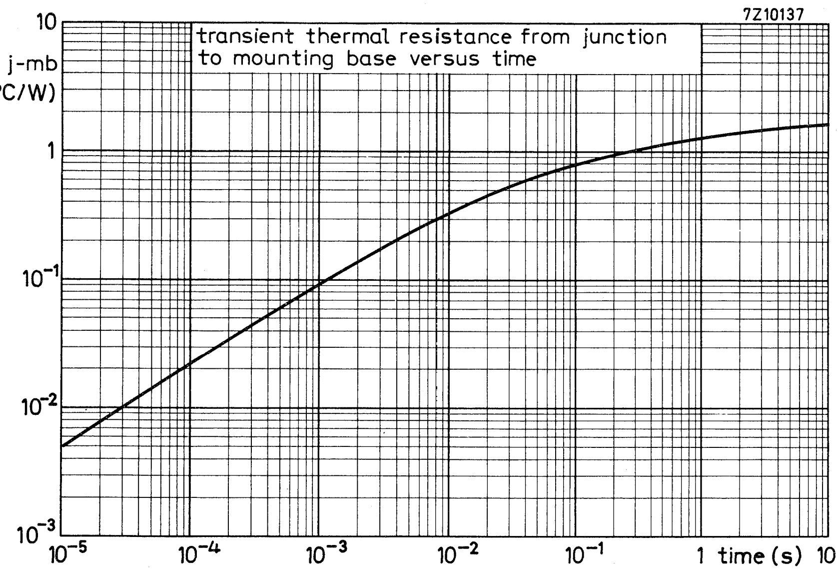

Typical turn on characteristics when switched from
V_D = 400V or 50V respectively to I_T = 1A, 10A or 50A
Gate source 5V, 25Ω
7Z05184-2.20.25.ia
V
(V)
400
300
200
100
0
I_T =
50A
10A
1A
0
2
4 t(μs)
60
40
20
0
V
(V)
I_T =
50A
10A
1A
0
2
4
t(μs)
6

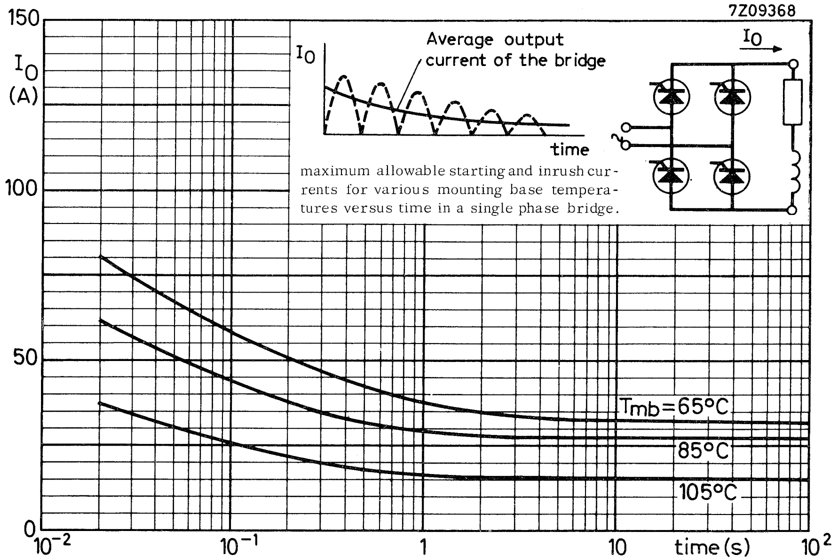

7Z09371
T_j = 25 to 125°C
200
I_T
(A)
150
100
50
0
max. voltage
0
2
4
V_T(V)
6

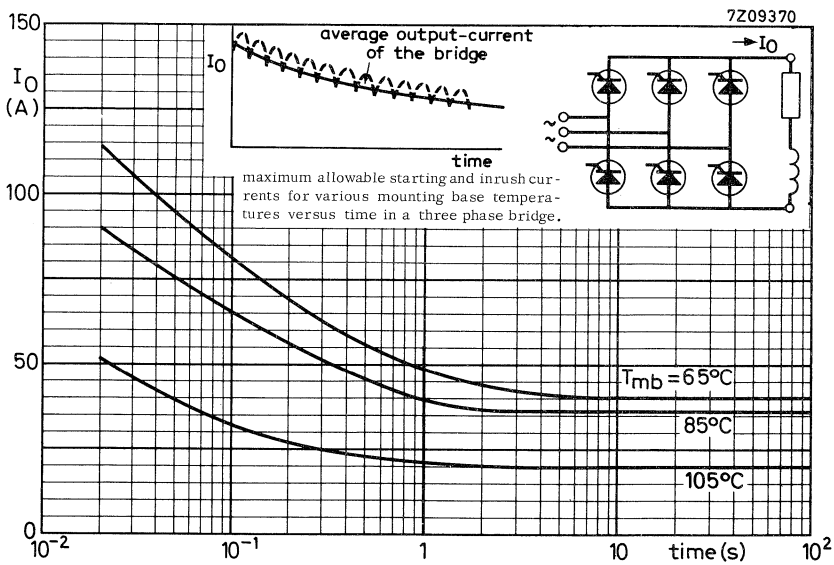


Gate characteristics with curves $P_{GAV} = 0.5W$


7Z05179.1
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 =
−55°C
+125°C
V_{FG} (V)
I_{FG} (mA)
0
20
40
60
80
100
120
1
2
3
4


7Z10137
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10


7Z09368
150
I_O
(A)
100
50
0
Average output
current of the bridge
I_O
time
I_O
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a single phase bridge.
T_{mb}=65°C
85°C
105°C
10^{-2}
10^{-1}
1
10
time (s)
10^2


7Z09370
150
I_O
(A)
100
50
0
average output-current
of the bridge
I_O
time
I_O
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a three phase bridge.
T_{mb}=65°C
85°C
105°C
10^{-2}
10^{-1}
1
10
time (s)
10^2

P-GATE SILICON THYRISTORS

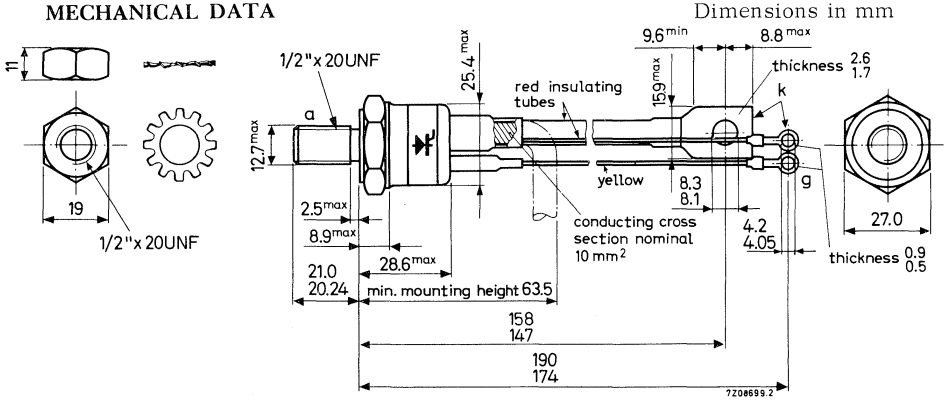
P-gate thyristors in a metal envelope with ceramic insulation. They are intended for power control and power switching applications.
The series consists of the reverse polarity types (anode to stud) BTY95-500R to BTY95-800R.

QUICK REFERENCE DATA

			BTY95-500R	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	$I_{T(AV)}$	max.	50				A
Non-repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	680				A
Junction temperature	T_j	max.	125				^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.6				$^oC/W$

MECHANICAL DATA

Dimensions in mm



Torque on nut: min. 90 kg cm
max. 175 kg cm

Net weight: 108 g

Diameter of clearance hole: max. 13 mm

All information applies to frequencies up to 400 Hz.

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])

		BTY95-500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	500	600	700	800	V
Repetitive peak reverse voltage	V_{RRM} max.	500	600	700	800	V
Non-repetitive peak reverse voltage (t < 5 ms)	V_{RSM} max.	600	720	850	960	V
Crest working off-state voltage	V_{DWM} max.	500	600	700	800	V
Repetitive peak off-state voltage	V_{DRM} max.	500	600	700	800	V
Non-repetitive peak off-state voltage	V_{DSM} max.	850	850	850	850	V [3])

Currents

Average forward current (averaged over any 20 ms period)	$I_{T(AV)}$	max.	50	A
Forward current (d.c.)	I_T	max.	75	A
R.M.S. forward current	$I_{T(RMS)}$	max.	78	A
Repetitive peak forward current	I_{TRM}	max.	700	A
Non-repetitive peak forward current (t = 10 ms) See page 11	I_{TSM}	max.	680	A
I squared t, for fusing (t = 1.5 to 10 ms)	I^2t	max.	2000	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/μs
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

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	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.02	$^oC/W$

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTY95-500R	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	V [1]
Forward breakover voltage	$V_{(BO)}$	>	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	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

Latching current	I_L	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 avoid excessive dissipation.

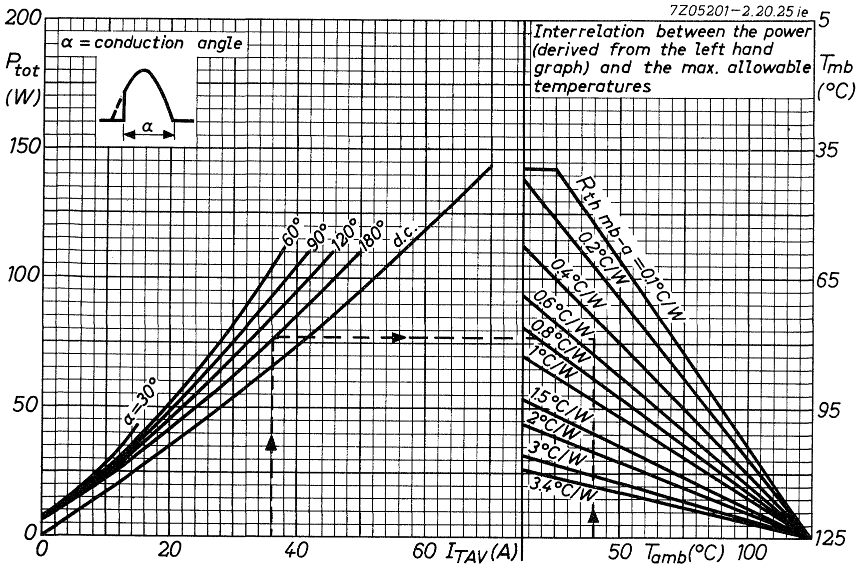
[2]) These I_R values apply to a gate voltage range of −5 to +0.25 V.

SWITCHING CHARACTERISTICS

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 $V_R \geq$ 50 V with $-dI/dt$ = 50 A/μs; dV_D/dt = 10 V/μs				
T_j = 125 °C	t_q	<	250	μs
T_j = 25 °C	t_q	<	100	μs

OPERATING NOTES

See general pages at the beginning of this section.



Determination of the heatsink thermal resistance

Example:
Assume a thyristor, used in a single phase full wave rectifier circuit.

conduction angle	α	=	180°	
average forward current	I_{TAV}	=	36	A (per thyristor)
ambient temperature	T_{amb}	=	40	°C

From the left hand part of the graph above it follows that at $I_{TAV} = 36$ A and $\alpha = 180°$ the average forward power + average leakage power = 77 W per thyristor.

From the right hand part of the graph above follows the thermal resistance, required for $P_{tot} = 77$ W at $T_{amb} = 40$ °C

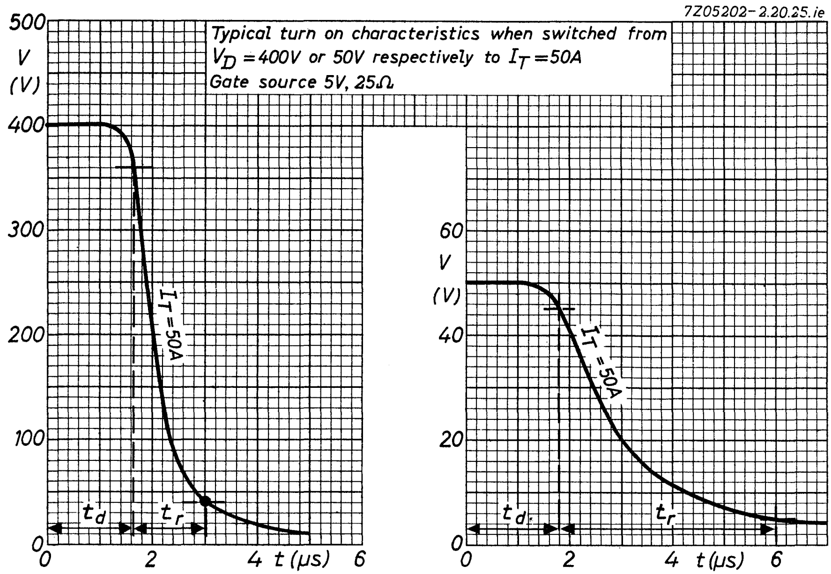
$$R_{th\ mb\text{-}a} \approx 0.52\ ^{o}C/W$$

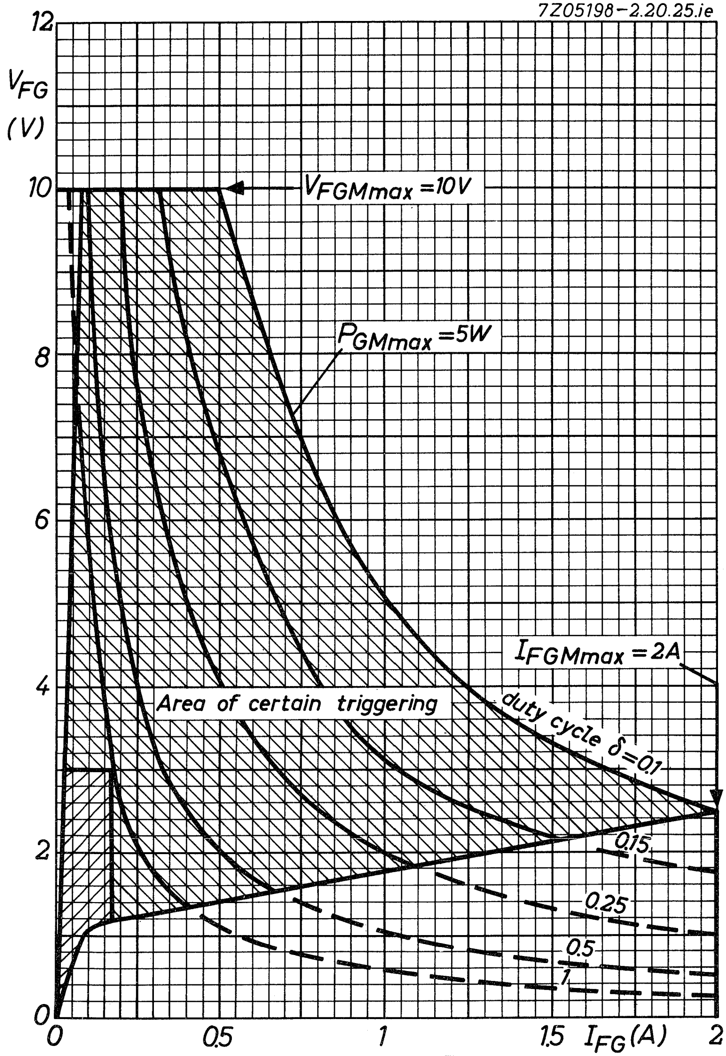
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.1\ ^{o}C/W$.

Hence the heatsink thermal resistance should be:

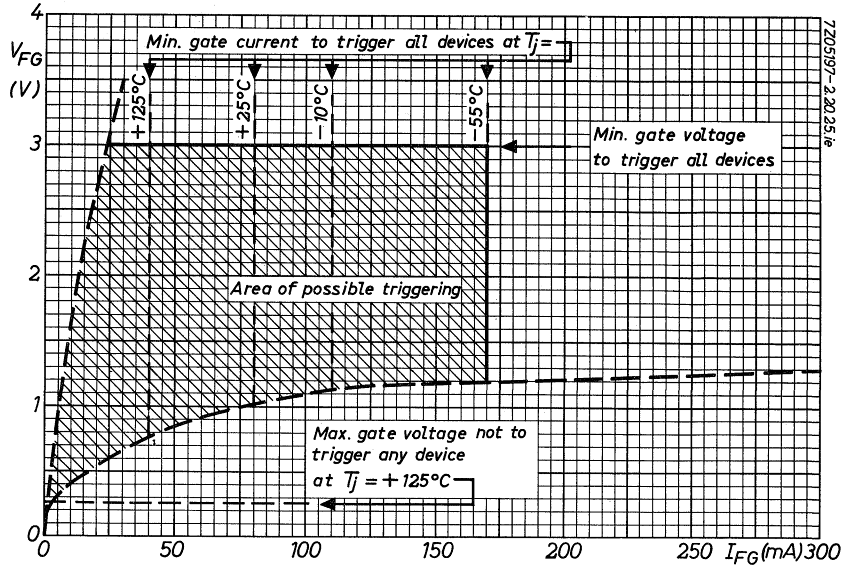
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (0.52 - 0.1)\ ^{o}C/W = 0.42\ ^{o}C/W.$$

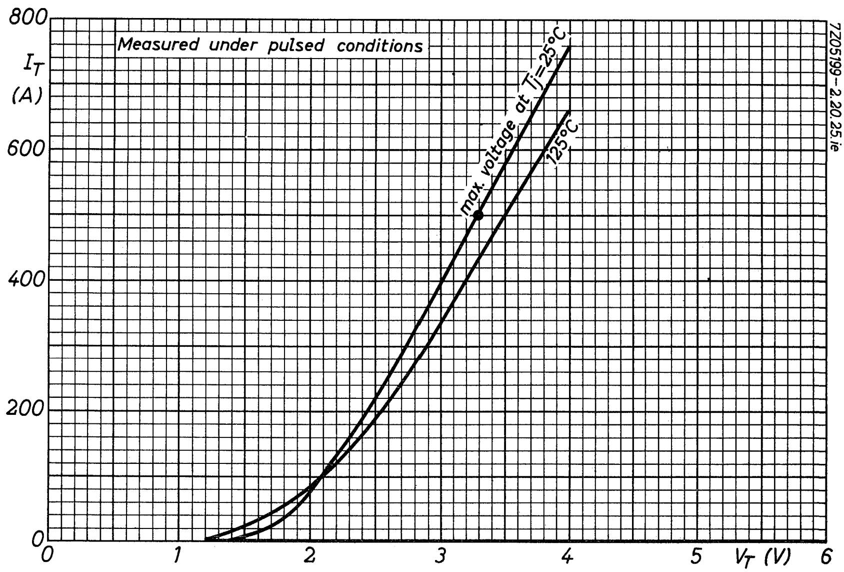
The applicable heatsink(s) may then be found in the Section HEATSINKS.

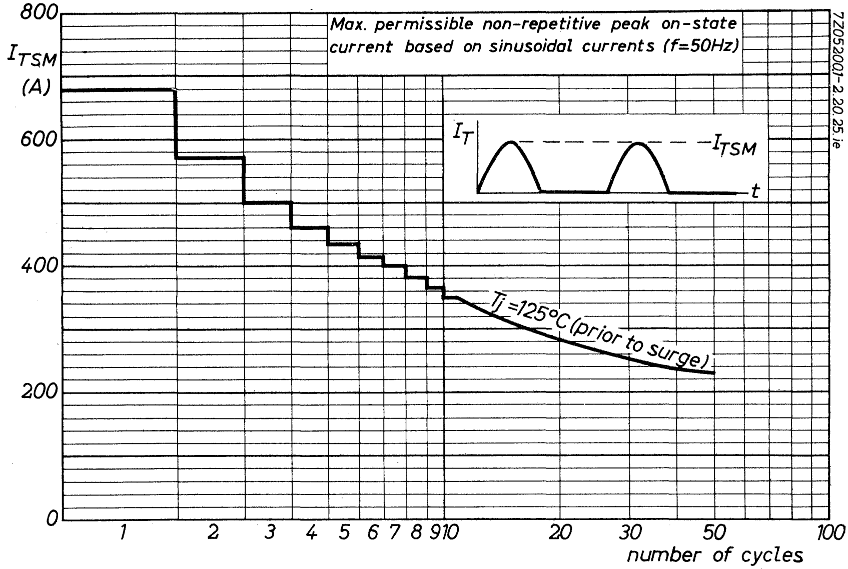

7Z05202-2.20.25.ie
Typical turn on characteristics when switched from
V_D = 400V or 50V respectively to I_T = 50A
Gate source 5V, 25Ω
500
V
(V)
400
300
200
100
0
I_T = 50A
t_d
t_r
0
2
4
t (μs)
6
60
V
(V)
40
20
0
I_T = 50A
t_d
t_r
0
2
4
t (μs)
6

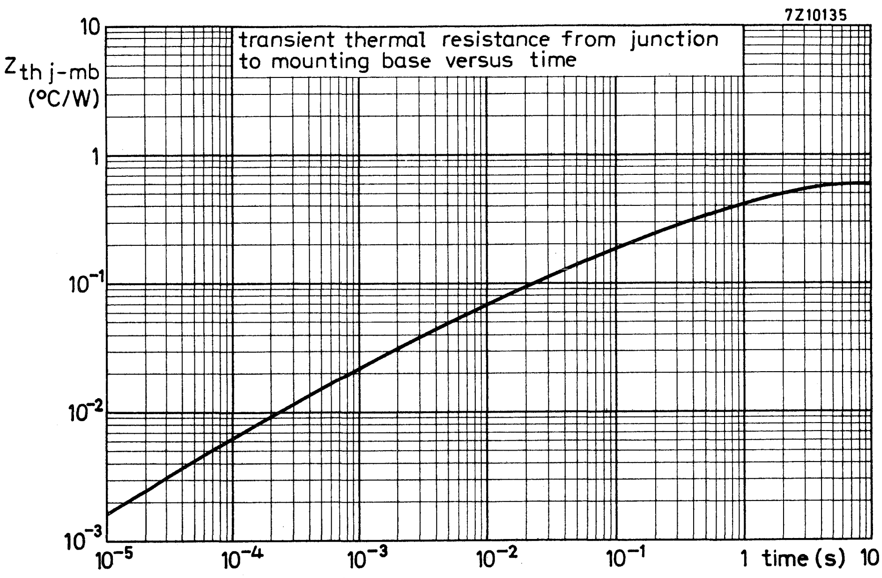


Gate characteristics with curves P_{GAV} = 0.5W


4
V_{FG}
(V)
3
2
1
0
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
0
50
100
150
200
250
I_{FG} (mA) 300
7Z05197-2.20.25.ie


800
I_T
(A)
600
400
200
0
Measured under pulsed conditions
max. voltage at T_j=25°C
125°C
0
1
2
3
4
5
V_T (V)
6
7Z05199-2.20.25.ie


800
I_{TSM}
(A)
600
400
200
0
Max. permissible non-repetitive peak on-state current based on sinusoidal currents (f=50Hz)
7Z052001-2.20.25.ie
I_T
I_{TSM}
t
T_j=125°C (prior to surge)
1
2
3
4
5
6
7
8
9
10
20
30
50
100
number of cycles

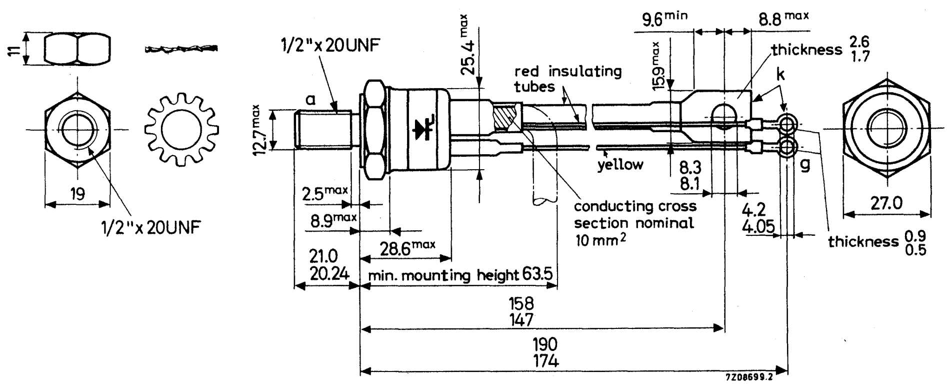

7Z10135
10
$Z_{th\ j-mb}$
(°C/W)
1
10^{-1}
10^{-2}
10^{-3}
transient thermal resistance from junction to mounting base versus time
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

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 reverse polarity types (anode to stud) BTY99-500R to BTY-800R.

QUICK REFERENCE DATA							
		BTY99-	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	$I_{T(AV)}$	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: 108 g

Diameter of clearance hole: max. 13 mm

Torque on nut: min. 90 kg cm

max. 175 kg cm

All information applies to frequencies up to 400 Hz.

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])		BTY99- 500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	500	600	700	800	V
Repetitive peak reverse voltage	V_{RRM} max.	500	600	700	800	V
Non-repetitive peak reverse voltage ($t < 5$ ms)	V_{RSM} max.	600	720	850	960	V
Crest working off-state voltage	V_{DWM} max.	500	600	700	800	V
Repetitive peak off-state voltage	V_{DRM} max.	500	600	700	800	V
Non-repetitive peak off-state voltage	V_{DSM} max.	850	850	850	850	V[3])

Currents

Average forward current (averaged over any 20 ms period)	$I_{T(AV)}$	max.	70	A
Forward current (d.c.)	I_T	max.	100	A
R.M.S. forward current	$I_{T(RMS)}$	max.	110	A
Repetitive peak forward current	I_{TRM}	max.	1000	A
Non-repetitive peak forward current ($t = 10$ ms) See page 11	I_{TSM}	max.	900	A
I squared t, for fusing ($t = 1.5$ to 10 ms)	I^2t	max.	4000	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	20	A/μs
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.

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	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	$R_{th\ j\text{-}mb}$	=	0.4	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	$^oC/W$
Transient thermal resistance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.02	$^oC/W$

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTY99-500R	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)
Forward breakover voltage	$V_{(BO)}$	>	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	V/μs

Currents

			BTY99-500R	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

Latching current	I_L	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 avoid excessive dissipation.

2) These I_R values apply to a gate voltage range of −5 to +0.25 V.

SWITCHING CHARACTERISTICS

Turn-on time when switched from

$V_D = 400$ V to $I_T = 50$ A
Gate source 5 V, 25 Ω; $T_j = 125^oC$ t_{on} typ. 3.0 μs

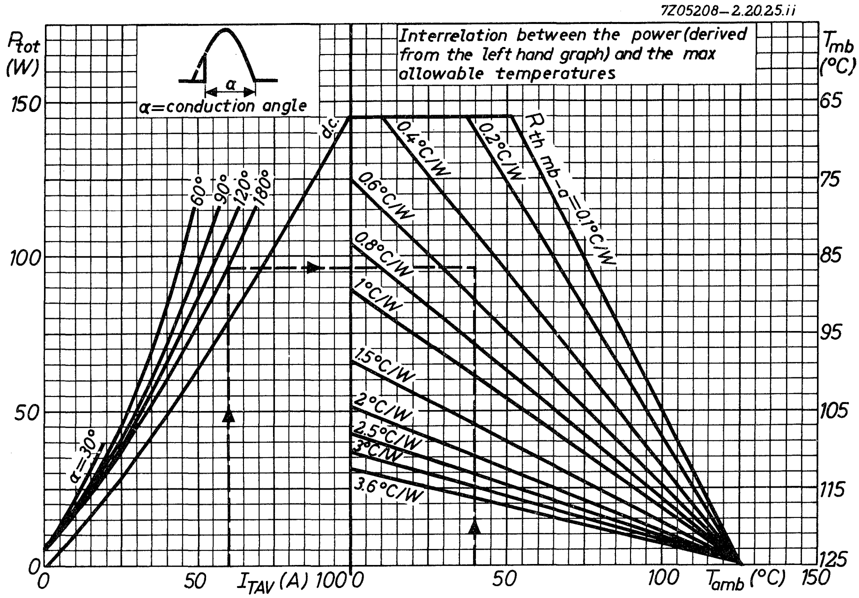
Turn-off time when switched from

$I_T = 50$ A to $V_R \geq 50$ V
with $-dI/dt = 50$ A/μs; $dV_D/dt = 10$ V/μs

$T_j = 125\ ^oC$	t_q	<	250	μs
$T_j = 25\ ^oC$	t_q	<	100	μs

OPERATING NOTES

See general pages at the beginning of this section.



Determination of the heatsink thermal resistance

Example:
Assume a thyristor, used in a single phase full wave rectifier circuit.

conduction angle	α	=	180^o	
average forward current	I_{TAV}	=	60	A (per thyristor)
ambient temperature	T_{amb}	=	40	^oC

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 of the graph above follows the thermal resistance, required for P_{tot} = 96 W at T_{amb} = 40 ^oC

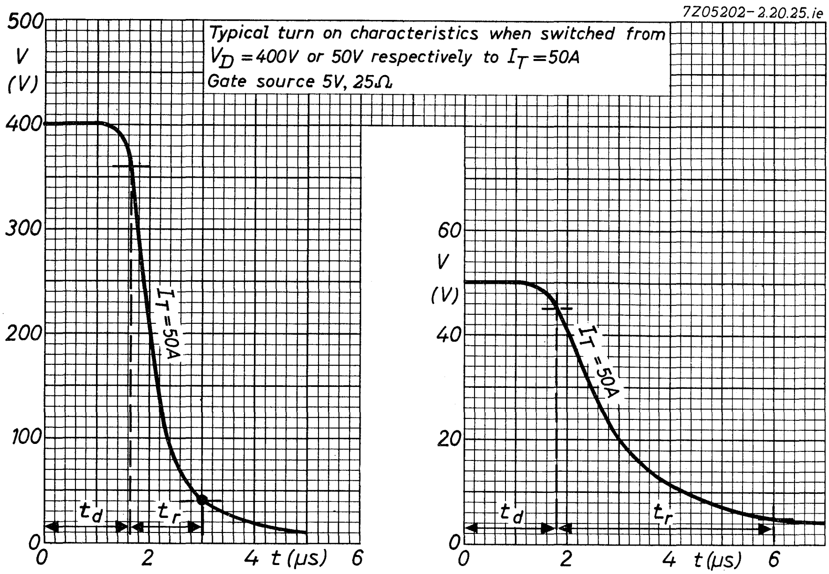
$$R_{th\ mb-a} \approx 0.5\ ^oC/W$$

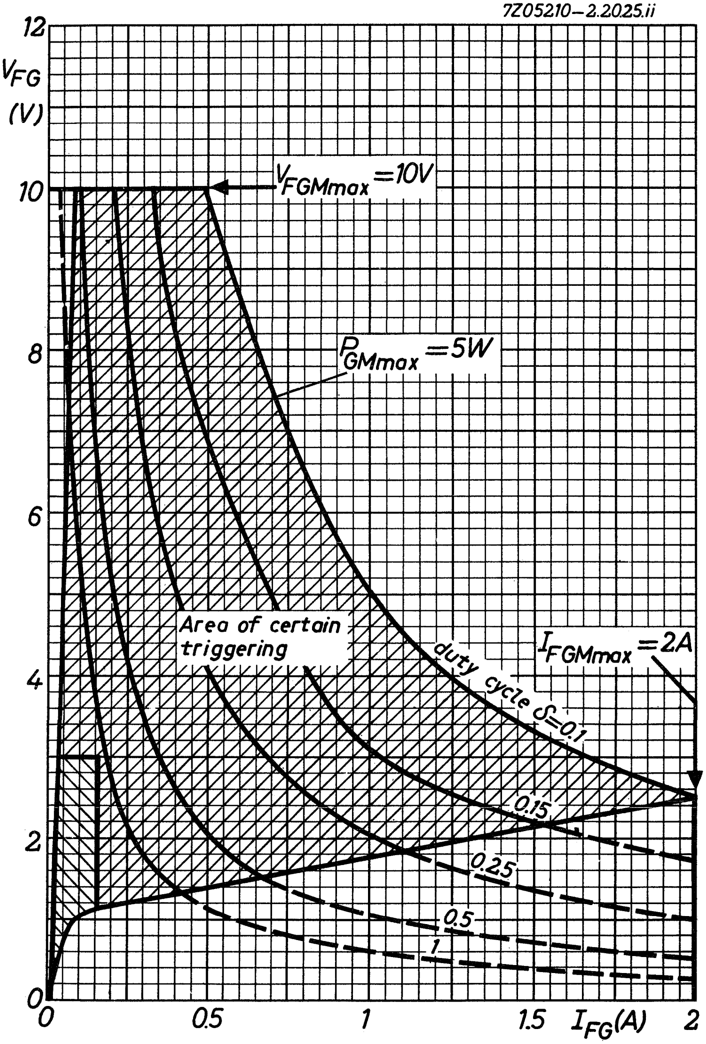
The contact thermal resistance $R_{th\ mb-h} = 0.1\ ^oC/W$.

Hence the heatsink thermal resistance should be:

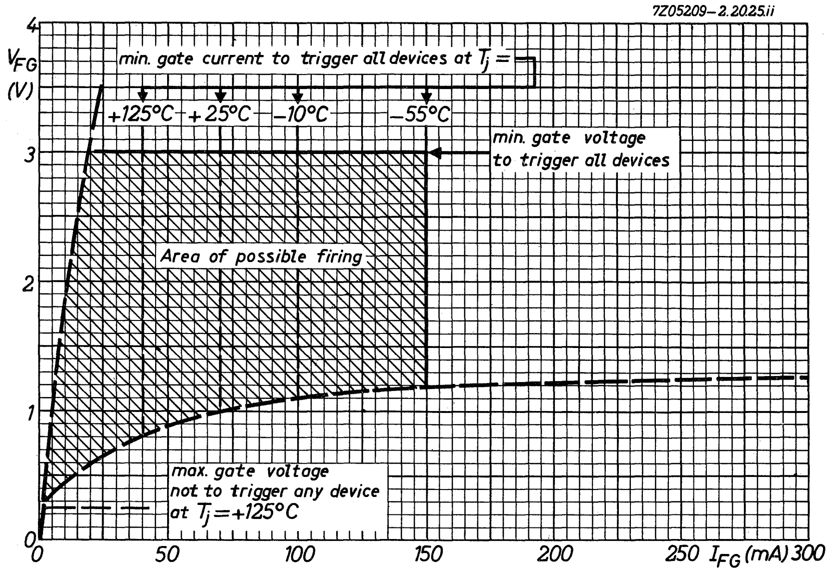
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (0.5 - 0.1)\ ^oC/W = 0.4\ ^oG/W.$$

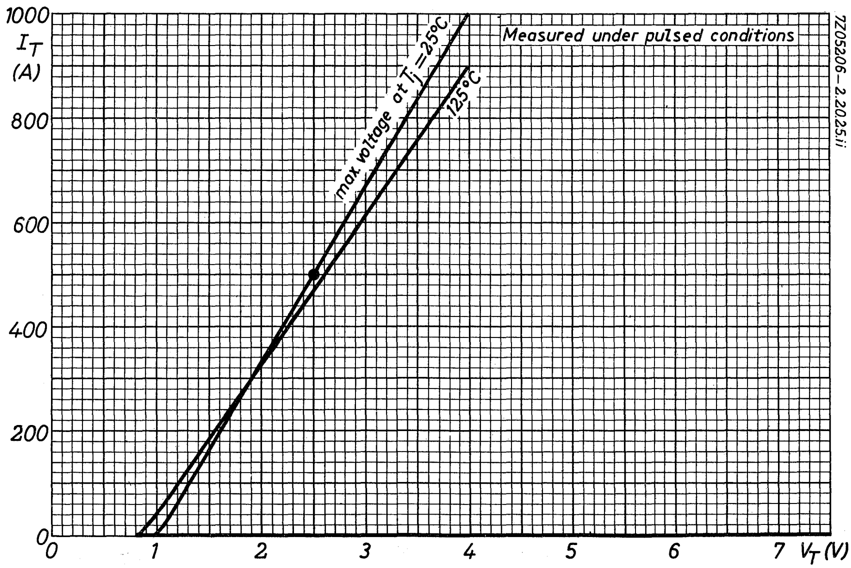
The applicable heatsink(s) may then be found in the Section HEATSINKS.

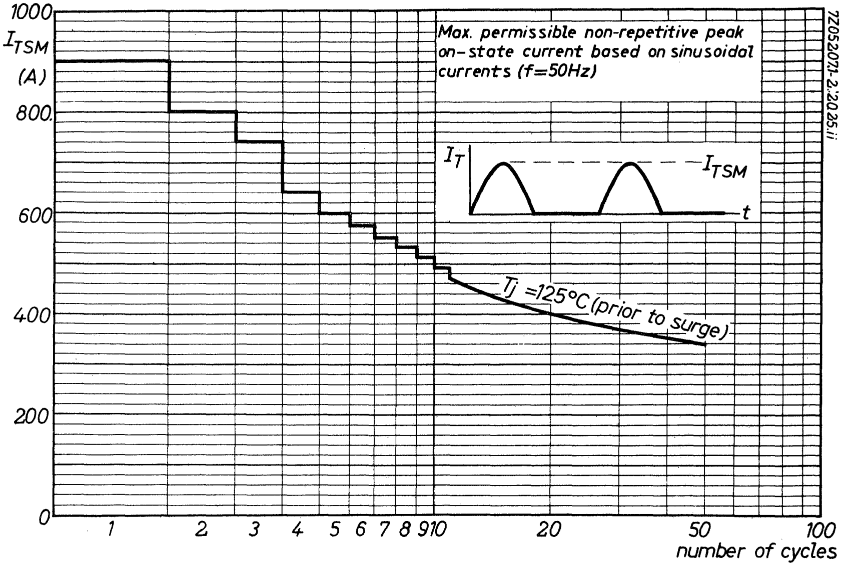

7Z05202-2.20.25.ie
Typical turn on characteristics when switched from
V_D = 400V or 50V respectively to I_T = 50A
Gate source 5V, 25Ω
500
V
(V)
400
300
200
100
0
0
2
4
t (μs)
6
t_d
t_r
I_T = 50A
60
V
(V)
40
20
0
0
2
4
t (μs)
6
t_d
t_r
I_T = 50A

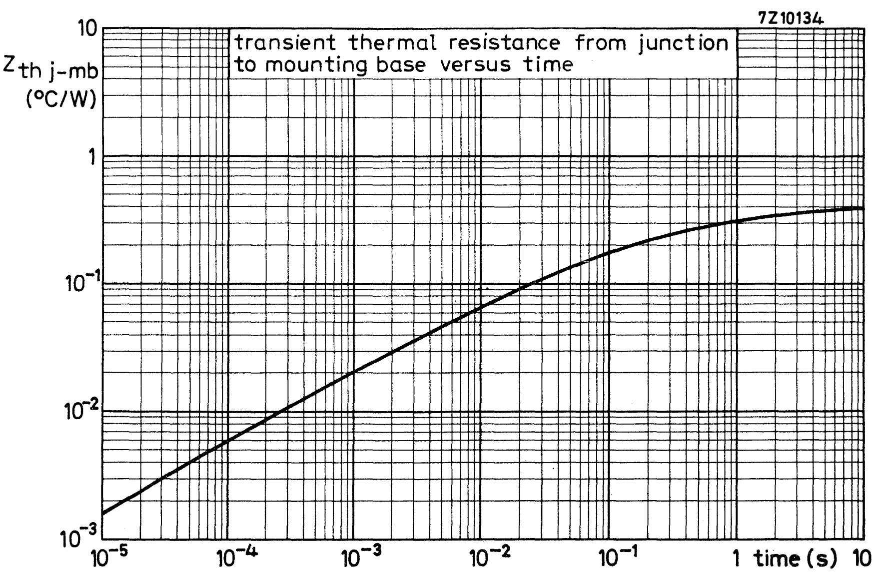


Gate characteristics with curves P_{GAV} =0.5W


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

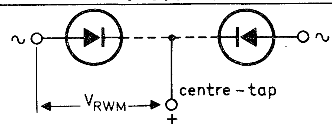
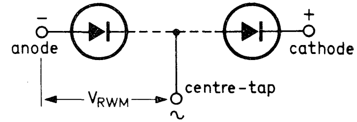
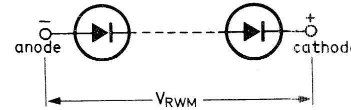

I_T (A)
Measured under pulsed conditions
7Z05206–2.20.25.ii
max. voltage at T_j = 25°C
125°C
V_T (V)
0
200
400
600
800
1000
1
2
3
4
5
6
7


7Z05207.1-2:20.25.ii
Max. permissible non-repetitive peak on-state current based on sinusoidal currents (f=50Hz)
1000
I_{TSM}
(A)
800
600
400
200
0
I_T
I_{TSM}
t
T_j =125°C (prior to surge)
1
2
3
4
5
6
7
8
9
10
20
50
100
number of cycles


7Z10134
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

Rectifier stacks

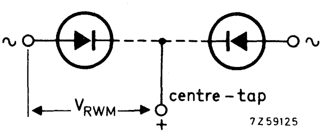
TYPE SELECTION CHART

Type number		OSB9110	OSB9210	OSB9310	OSB9410	OSM9110	OSM9210	OSM9310	OSM9410	OSS9110	OSS9210	OSS9310	OSS9410
Number of diodes		4.6...28.30				4.6...28.30				3.4....29.30			
Circuit													
Crest working reverse voltage		2.3...14.15 kV				2.3...14.15 kV				3.4....29.30 kV			
	T_{amb} = 35 °C	3.5 A	5 A	4 A	10 A	3.5 A	5 A	4 A	10 A	3.5 A	5 A	4 A	10 A
Average forward current per diode at:	T_{oil} = 30 °C		20 A				20 A				20 A		
	T_{oil} = 35 °C				30 A				30 A				30 A
	T_{oil} = 65 °C			12 A				12 A				12 A	
	T_{oil} = 100 °C	6 A				6A				6 A			
Non-repetitive peak forward current		85 A	360 A	180 A	800 A	85 A	360 A	180 A	800 A	85 A	360 A	180 A	800 A
Base		A = 1/4" UNF-studs at the ends B = 4 pin Super Jumbo (B4D) C = Goliath E = 4 pin Jumbo (B4F) F = A3-20											

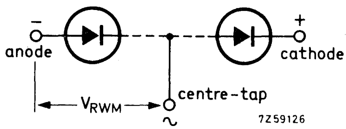
HIGH VOLTAGE RECTIFIER STACKS

The OSB9110, OSM9110 and OSS9110series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. The OSB9110series is intended for application in two phase half wave rectifier circuits. The OSM9110series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9110series is intended for all kinds of high voltage rectification. The assemblies are supplied with 1/4"UNF studs or with standard valve bases. The OSB9110-series and OSM9110series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9110 and OSM9110series cover the range from 2 kV to 15 kV, and of the OSS9110series the range from 3 kV to 30 kV, in 1 kV steps.

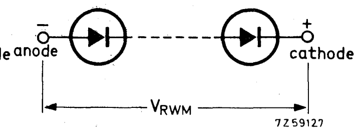
CIRCUIT OSB 9110



CIRCUIT OSM 9110



CIRCUIT OSS 9110



QUICK REFERENCE DATA

		OSB9110	−4	−6	. . .	−28	−30	
		OSM9110	−4	−6	. . .	−28	−30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3	. . .	14	15	kV
		OSS9110	−3	−4	. . .	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	. . .	29	30	kV
Average forward current with R and L load (averaged over any 20 ms period)								
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.					3.5	A
in oil up to T_{oil} = 100 °C	$I_{F(AV)}$	max.					6	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.					85	A

MECHANICAL DATA see pages 4 and 5.

All information applies to frequencies up to 400 Hz

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

Voltages

		OSB9110	-4	-6	...	-28	-30	
		OSM9110	-4	-6	...	-28	-30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV

		OSS9110	-3	-4	...	-29	-30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 ^{o}C	$I_{F(AV)}$	max.	3.5	A
in oil up to T_{oil} = 100 ^{o}C	$I_{F(AV)}$	max.	6	A
Repetitive peak forward current	I_{FRM}	max.	120	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 ^{o}C prior to surge	I_{FSM}	max.	85	A

Reverse power dissipation

		OSB9110	-4	-6	...	-28	-30	
		OSM9110	-4	-6	...	-28	-30	
Repetitive peak reverse power t = 10 μs (square wave; f = 50 Hz) T_j = 175 ^{o}C	P_{RRM}	max.	1.2	1.8	...	8.4	9	kW
Non-repetitive peak reverse power t = 10 μs (square wave)								
T_j = 25 ^{o}C prior to surge	P_{RSM}	max.	6	9	...	42	45	kW
T_j = 175 ^{o}C prior to surge	P_{RSM}	max.	1.2	1.8	...	8.4	9	kW

		OSS9110	-3	-4	...	-29	-30	
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 175 ^{o}C	P_{RRM}	max.	1.8	2.4	...	17.4	18	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave)								
T_j = 25 ^{o}C prior to surge	P_{RSM}	max.	9	12	...	87	90	kW
T_j = 175 ^{o}C prior to surge	P_{RSM}	max.	1.8	2.4		17.4	18	kW

Temperatures

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

CHARACTERISTICS (See note 1)

			OSB9110	-4	-6	...	-28	-30	
			OSM9110	-4	-6	...	-28	-30	
Forward voltage									
I_F = 20 A; T_j = 25 °C	V_F	<		4	6	...	28	30	V
Reverse avalanche breakdown voltage [1]									
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>		2.5	3.75	...	17.5	18.75	kV
		<		3.76	5.64	...	26.32	28.2	kV

			OSS9110	-3	-4	...	-29	-30	
Forward voltage									
I_F = 20 A; T_j = 25 °C	V_F	<		6	8	...	58	60	V
Reverse avalanche breakdown voltage [1]									
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>		3.75	5.0	...	36.25	37.5	kV
		<		5.64	7.52	...	54.52	56.4	kV

Reverse current

$V_{RM} = V_{RWM\,max}$; T_j = 125 °C — I_{RM} < 0.6 mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9110series)
2. Type number suffix

   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = 1/4"U.N.F. studs at the ends.
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20
3. Operating position

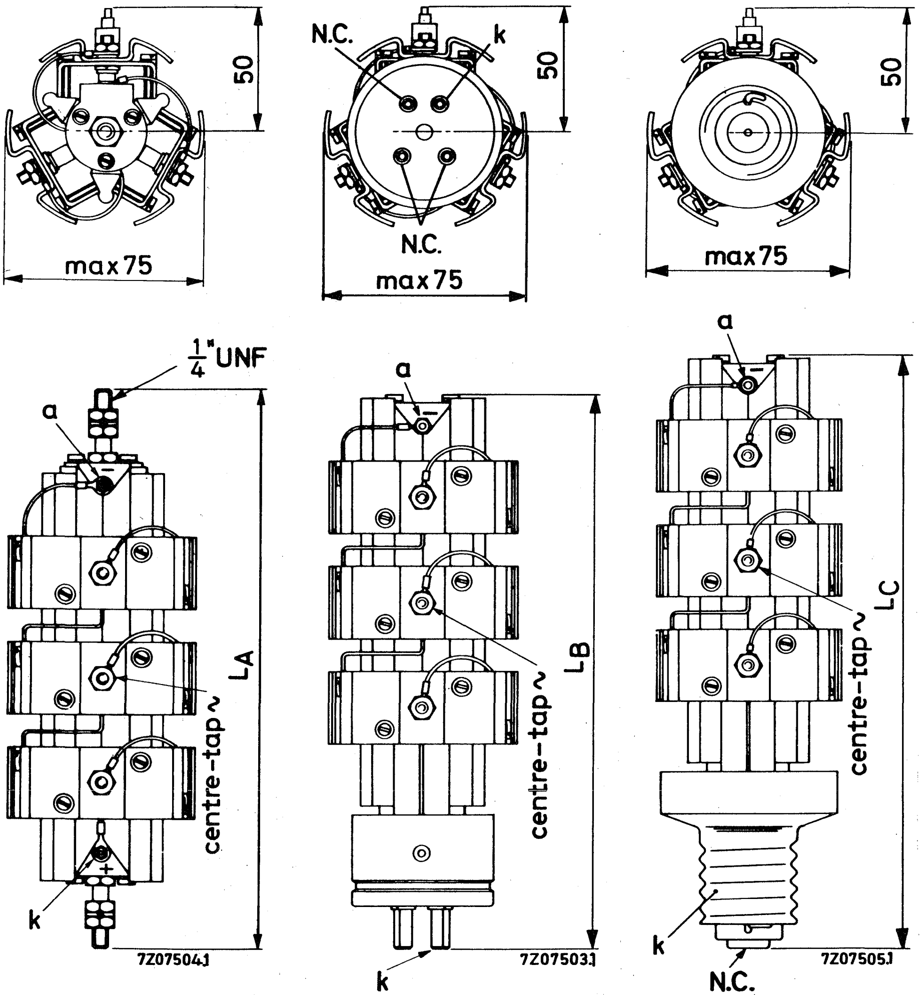
   The rectifier units can be operated at their maximum ratings when mounted in any position.

[1]) The breakdown voltage increases by approximately 0.1% per °C with increasing junction temperature.

MECHANICAL DATA Dimensions in mm

n = total number of diodes

OSM9110-nA OSM9110-nB OSM9110-nC



The drawings show the OSM9110series; the OSB9110 and OSS9110series differ in the following respects:

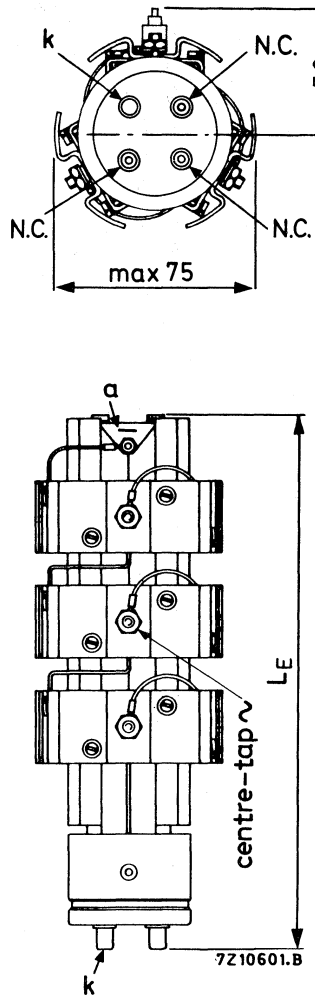
OSB9110series – terminals marked a(-) and k(+) in the drawings are both marked ∿ ; the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9110series – has no centre-tap.

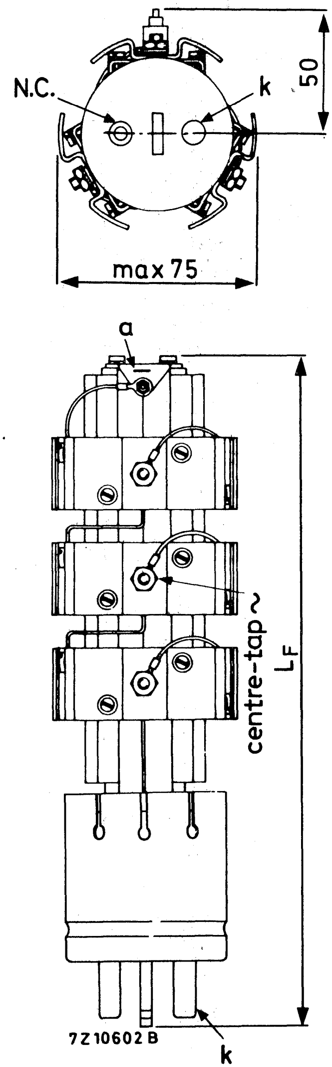
MECHANICAL DATA (continued)

n = total number of diodes.

OSM9110-nE



OSM9110-nF

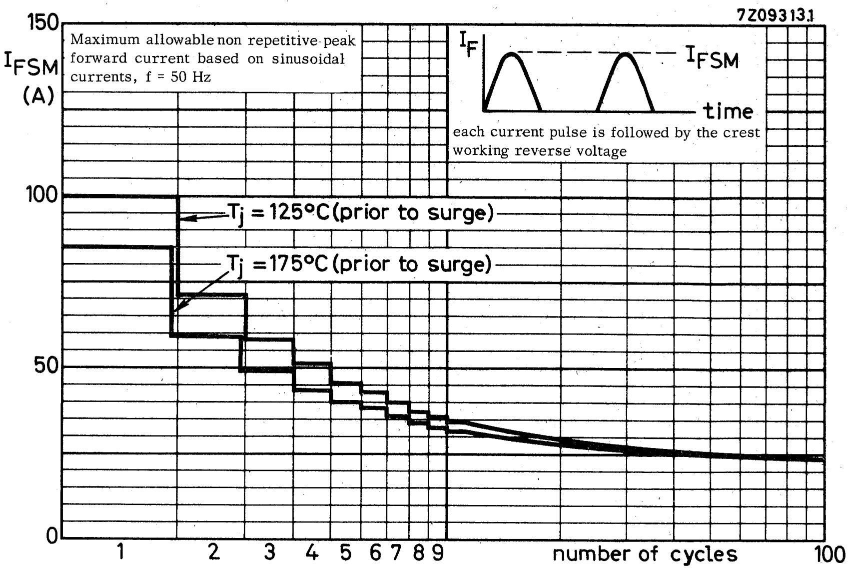


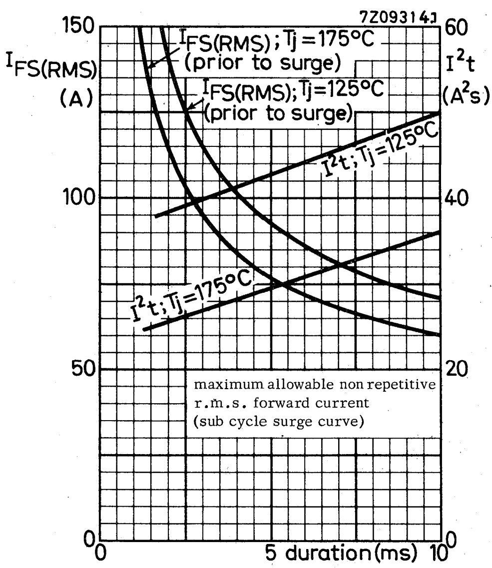
For lengths and weights see table on page 6.

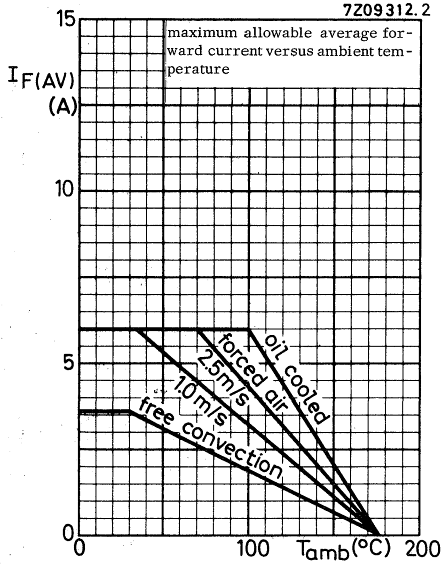
Table of lengths and weights (mm and g)

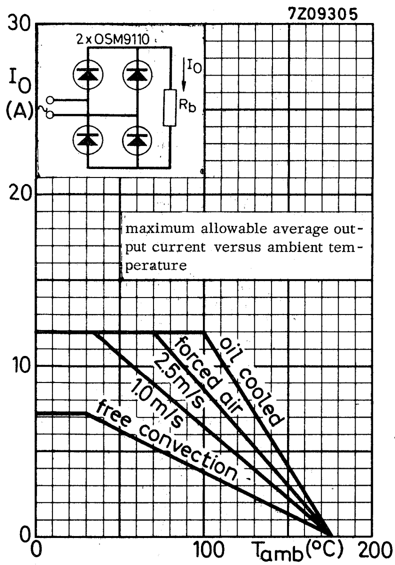
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weights	W_A	153	286	419	552	685
	$W_B = W_C = W_E$	218	351	484	617	750
	W_F	379	512	645	778	911

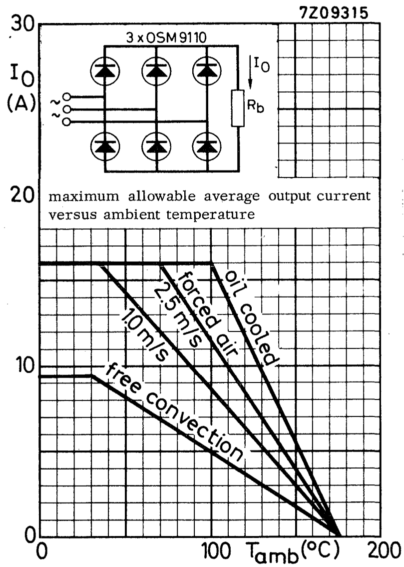
number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1048	1217	1350
	$W_B = W_C = W_E$	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z09313.1
150
IFSM
(A)
Maximum allowable non repetitive peak forward current based on sinusoidal currents, f = 50 Hz
IF
IFSM
time
each current pulse is followed by the crest working reverse voltage
100
Tj = 125°C (prior to surge)
Tj = 175°C (prior to surge)
50
0
1
2
3
4
5
6
7
8
9
number of cycles
100


7Z09314.1
150
IFS(RMS)
(A)
IFS(RMS); Tj = 175°C (prior to surge)
IFS(RMS); Tj=125°C (prior to surge)
I2t; Tj=125°C
I2t; Tj=175°C
100
50
0
60
I2t
(A2s)
40
20
0
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
0
5 duration (ms)
10

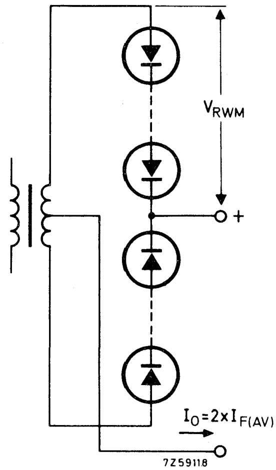

7Z09312.2
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
15
10
5
0
0
100
200
T_{amb} (°C)
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection


7Z09305
2 x OSM9110
I_O
R_b
maximum allowable average output current versus ambient temperature
I_O (A)
30
20
10
0
0
100
200
T_{amb} (°C)
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection

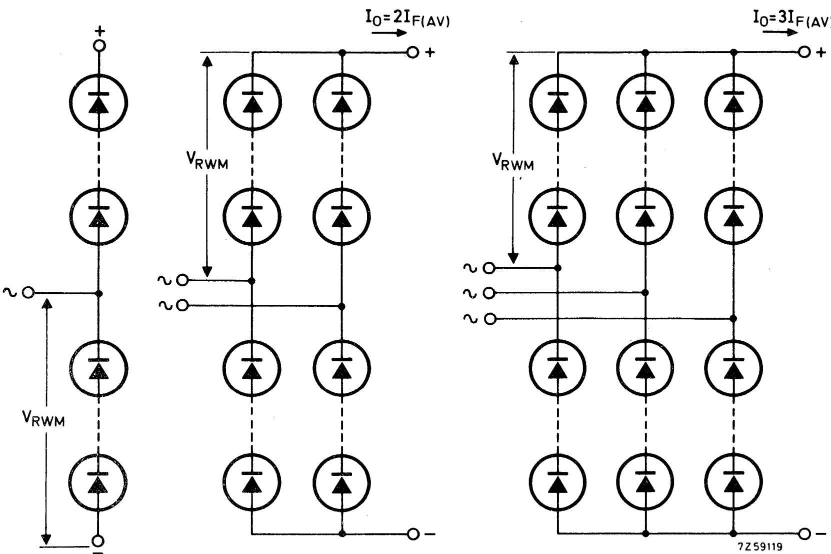

7Z09315
3 x OSM9110
I_O
R_b
maximum allowable average output current versus ambient temperature
I_O (A)
30
20
10
0
0
100
200
T_{amb} (°C)
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection

APPLICATION INFORMATION

OSB9110-4



OSM9110series



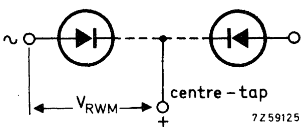
voltage doubler
1x OSM 9110

rectifier circuits with respectively
2x OSM 9110 and 3x OSM 9110

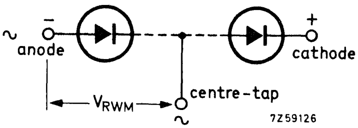
HIGH VOLTAGE RECTIFIER STACKS

The OSB9210, OSM9210 and OSS9210series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. The OSB9210series is intended for application in two phase half wave rectifier circuits. The OSM9210series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9210series is intended for all kinds of high voltage rectification. The assemblies are supplied with 1/4"UNF studs or with standard valve bases. The OSB9210-series and OSM9210series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9210 and OSM9210series cover the range from 2 kV to 15 kV, and of the OSS9210series the range from 3 kV to 30 kV, in 1 kV steps.

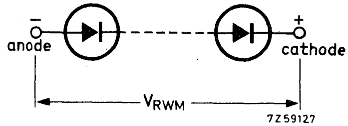
CIRCUIT OSB9210



CIRCUIT OSM9210



CIRCUIT OSS9210



QUICK REFERENCE DATA

		OSB9210	-4	-6	...	-28	-30	
		OSM9210	-4	-6	...	-28	-30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9210	-3	-4	...	-29	-30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Average forward current with R and L load (averaged over any 20 ms period)

in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	5	A
in oil up to T_{oil} = 100 °C	$I_{F(AV)}$	max.	20	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	360	A

MECHANICAL DATA see page 4 and 5

All information applies to frequencies up to 400 Hz

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

Voltages

		OSB9210	−4	−6	...	−28	−30	
		OSM9210	−4	−6	...	−28	−30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9210	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	5	A
in oil up to T_{oil} = 100 °C	$I_{F(AV)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	440	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	360	A

Reverse power dissipation

		OSB9210	−4	−6	...	−28	−30	
		OSM9210	−4	−6	...	−28	−30	
Repetitive peak reverse power t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	4	6	...	28	30	kW
Non-repetitive peak reverse power t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	26	39	...	182	195	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	4	6	...	28	30	kW
		OSS9210	−3	−4	...	−29	−30	kW
Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	6	8	...	58	60	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	39	52	...	377	390	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	6	8		58	60	kW

Temperatures

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

CHARACTERISTICS (See note 1)

			OSB9210					
			OSB9210 −4	−6	...	−28	−30	
			OSM9210−4	−6	...	−28	−30	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	3.6	5.4	...	25.2	27	V
Reverse breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	2.5	3.75	...	17.5	18.75	kV
		<	3.76	5.64	...	26.32	28.2	kV

			OSS9210 −3	−4	...	−29	−30	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	5.4	7.2	...	52.2	54	V
Reverse breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	3.75	5.0	...	36.25	37.5	kV
		<	5.64	7.52	...	54.52	56.4	kV

Reverse current

$V_{RM} = V_{RWM\,max}$; T_j = 125 °C $\quad I_{RM} < 0.6$ mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9210series).
2. Type number suffix

   The suffix sonsists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = 1/4"U.N.F. studs at the ends.
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20
3. Operating position

   The rectifier units can be operated at their maximum ratings when mounted in any position.

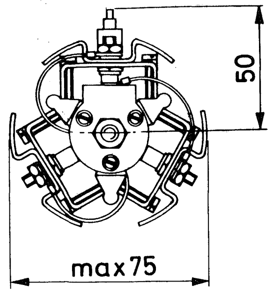
[1]) The breakdown voltage increases by approximately 0.1 % per °C with increasing junction temperature.

MECHANICAL DATA

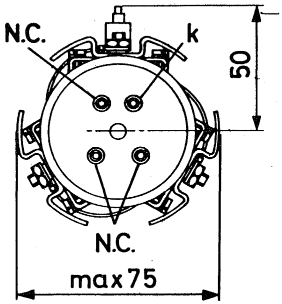
Dimensions in mm

n = total number of diodes

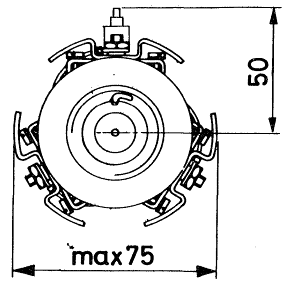
OSM9210-nA

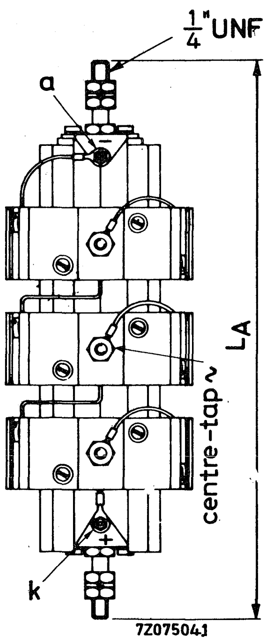


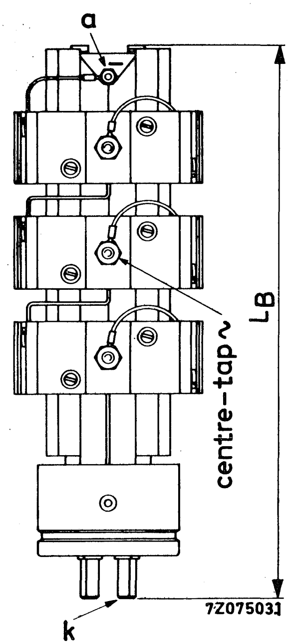
OSM9210-nB

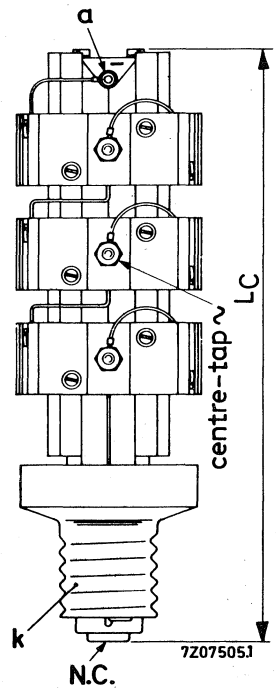


OSM9210-nC









The drawings show the OSM9210series; the OSB9210 and OSS9210series differ in the following respects:

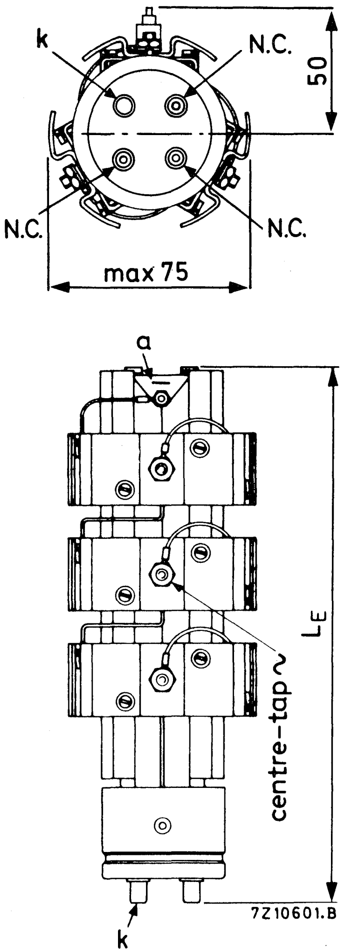
OSB9210series – terminals marked a(-) and k(+) in the drawings are both marked ∿; the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9210series – has no centre-tap.

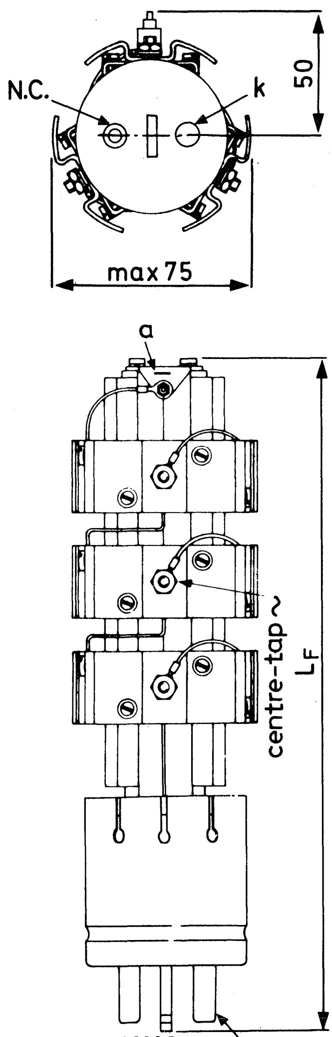
MECHANICAL DATA

n = total number of diodes.

OSM9210-nE



OSM9210-nF

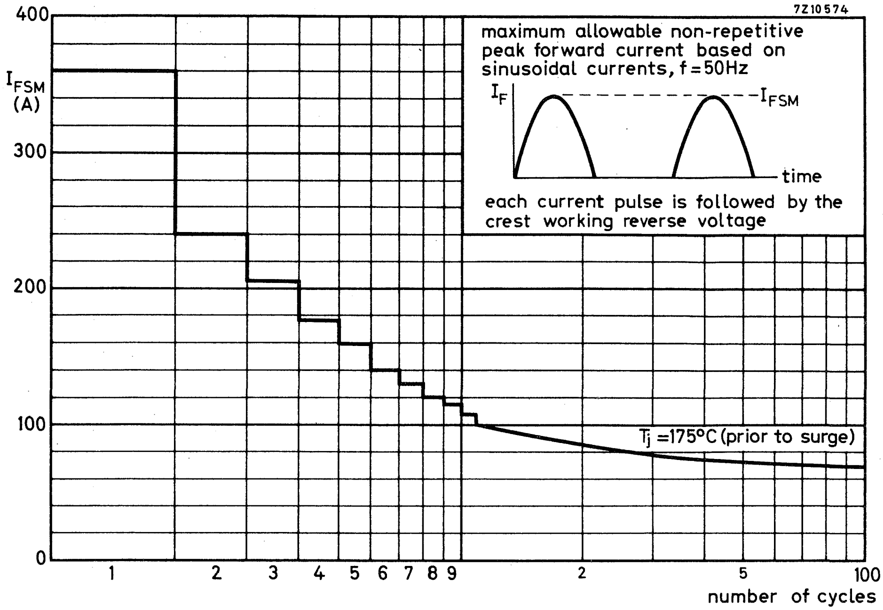


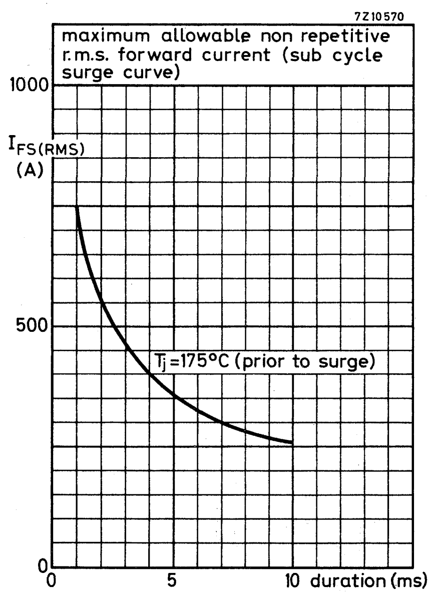
For lengths and weights see table on page 6.

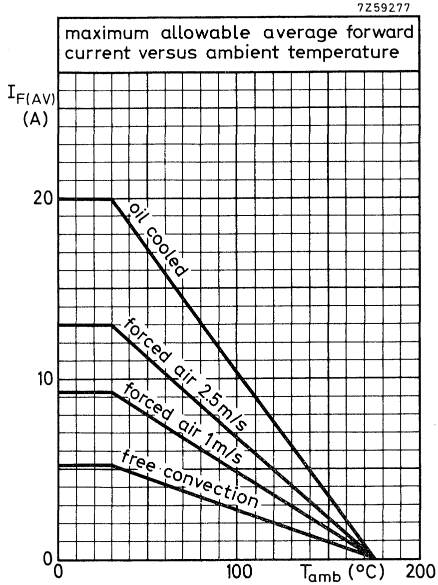
Table of lengths and weights (mm and g)

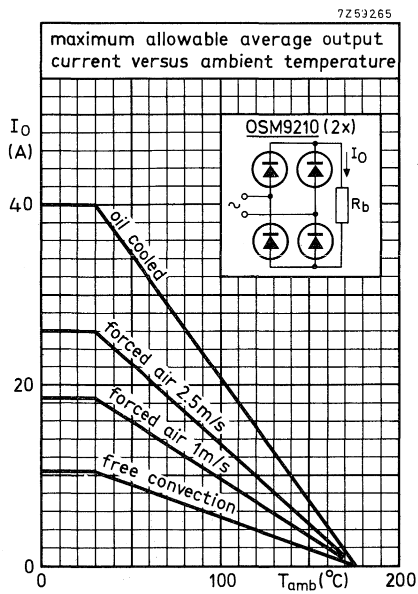
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weight	W_A	153	286	419	552	685
$W_B = W_C =$	W_E	218	351	484	617	750
	W_F	379	512	645	778	911

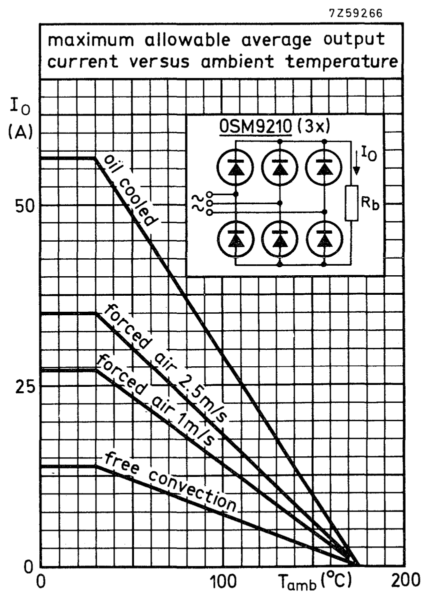
number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1084	1217	1350
$W_B = W_C =$	W_E	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z10574
maximum allowable non-repetitive peak forward current based on sinusoidal currents, f = 50Hz
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
I_{FSM} (A)
400
300
200
100
0
1
2
3
4
5
6
7
8
9
2
5
100
number of cycles
T_j = 175°C (prior to surge)


7Z10570
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
$I_{FS(RMS)}$ (A)
1000
500
0
0
5
10
duration (ms)
T_j = 175°C (prior to surge)

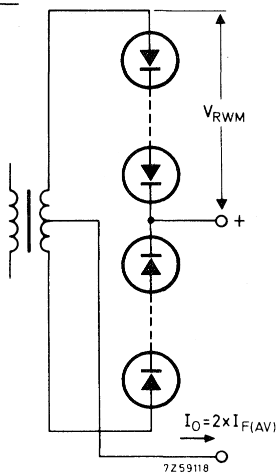

7Z59277
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
20
10
0
0
100
T_{amb} (°C)
200
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection


7Z59265
maximum allowable average output current versus ambient temperature
I_O (A)
40
20
0
0
100
T_{amb} (°C)
200
OSM9210 (2x)
I_O
R_b
~
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

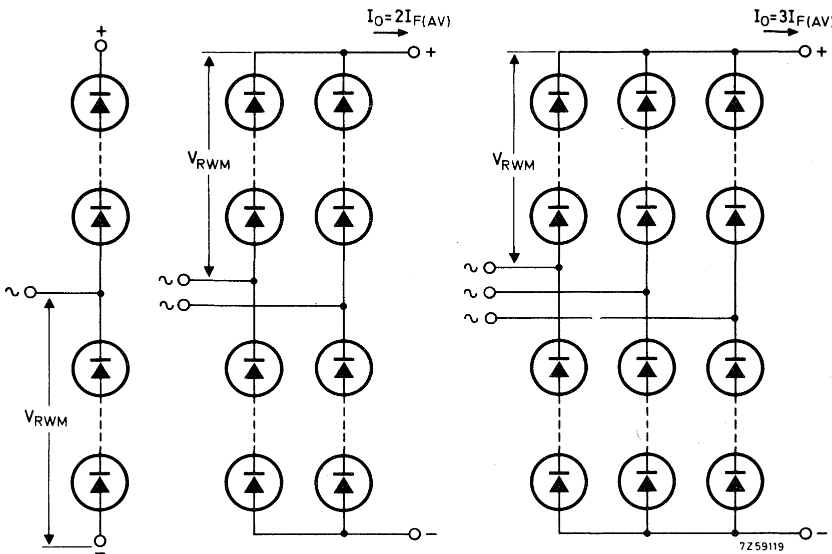

7Z59266
maximum allowable average output current versus ambient temperature
I_O (A)
50
25
0
0
100
T_{amb} (°C)
200
OSM9210 (3x)
I_O
R_b
≈
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

APPLICATION INFORMATION

OSB9210-4



OSM9210series



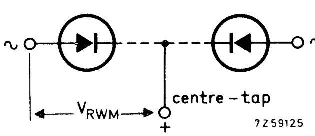
voltage doubler
1x OSM9210

rectifier circuits with respectively
2x OSM9210 and 3x OSM9210

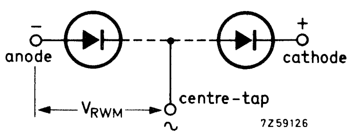
HIGH VOLTAGE RECTIFIER STACKS

The OSB9310, OSM9310 and OSS9310 series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. The OSB9310 series is intended for application in two phase half wave rectifier circuits. The OSM9310 series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9310 series is intended for all kinds of high voltage rectification. The assemblies are supplied with 1/4"UNF studs or with standard valve bases. The OSB9310 series and OSM9310 series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9310 and OSM9310 series cover the range from 2 kV to 15 kV, and of the OSS9310 series the range from 3 kV to 30 kV, in 1 kV steps.

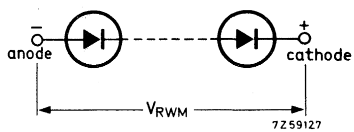
circuit OSB 9310



circuit OSM 9310



circuit OSS 9310



QUICK REFERENCE DATA

			OSB9310	−4	−6	...	−28	−30	
			OSM9310	−4	−6	...	−28	−30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.		2	3	...	14	15	kV
			OSS9310	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.		3	4	...	29	30	kV

Average forward current with R and L load (averaged over any 20 ms period)				
in free air up to $T_{amb} = 35^oC$	$I_{F(AV)}$	max.	4	A
in oil up to $T_{oil} = 65^oC$	$I_{F(AV)}$	max.	12	A
Non-repetitive peak forward current $t = 10$ ms; half sine wave; $T_j = 175^oC$ prior to surge	I_{FSM}	max.	180	A

MECHANICAL DATA see page 4 and 5

All information applies to frequencies up to 400 Hz

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

Voltages

		OSB9310	–4	–6	...	–28	–30	
		OSM9310	–4	–6	...	–28	–30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9310	–3	–4	...	–29	–30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	4	A
in oil up to T_{oil} = 65 °C	$I_{F(AV)}$	max.	12	A
Repetitive peak forward current	I_{FRM}	max.	250	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	180	A

Reverse power dissipation

		OSB9310	–4	–6	...	–28	–30	
Repetive peak reverse power dissipation		OSM9310	–4	–6	...	–28	–30	
t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	2	3	...	14	15	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	12	18	...	84	90	kW
T_j =175 °C prior to surge	P_{RSM}	max.	2	3	...	14	15	kW
Repetitive peak reverse power dissipation		OSS9310	–3	–4		–29	–30	
t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	3	4	...	29	30	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	18	24	...	174	180	kW
T_j =175 °C prior to surge	P_{RSM}	max.	3	4		29	30	kW

Temperatures

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

CHARACTERISTICS (see note 1)

			OSB9310	-4	-6	...	-28	-30	
Forward voltage			OSM9310	-4	-6	...	-28	-30	
I_F = 50 A; T_j = 25°C	V_F	<		5	7.5	...	35	37.5	V
Reverse breakdown voltage [1]									
I_R = 5 mA; T_j = 25°C	$V_{(BR)R}$	>		2.5	3.75	...	17.5	18.75	kV
		<		4	6	...	28	30	kV
			OSS9310	-3	-4	...	-29	-30	
Forward voltage									
I_F = 50 A; T_j = 25°C	V_F	<		7.5	10	...	72.5	75	V
Reverse breakdown voltage [1]									
I_R = 5 mA; T_j = 25°C	$V_{(BR)R}$	>		3.75	5.0	...	36.25	37.5	kV
		<		6	8	...	58	60	kV

Reverse current

$V_{RM} = V_{RWM\,max}$; T_j = 125°C I_{RM} < 0.3 mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9310 series).

2. Type number suffix

   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = 1/4"U.N.F. studs at the ends.
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20

3. Operating position

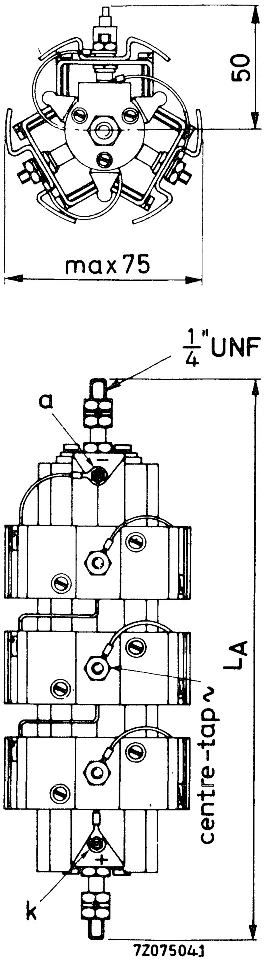
   The rectifier units can be operated at their maximum ratings when mounted in any position.

[1] The breakdown voltage increases by approximately 0.1% per °C with increasing junction temperature.

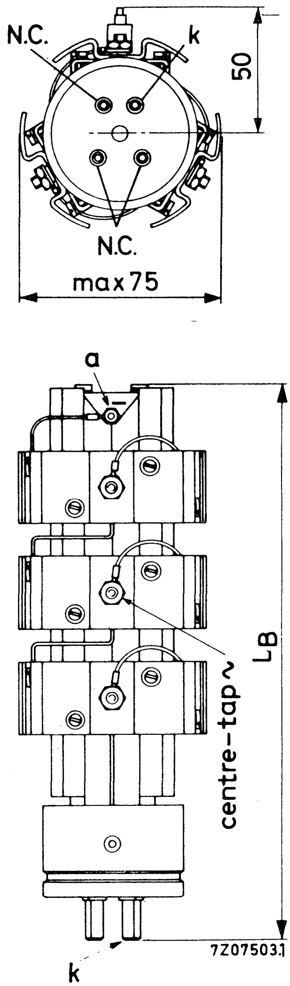
MECHANICAL DATA Dimensions in mm

n = total number of diodes

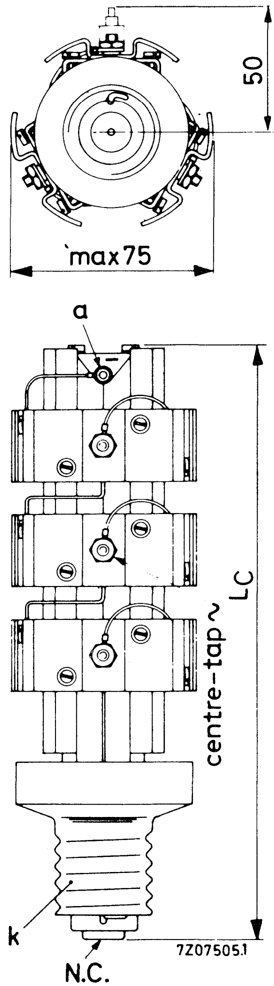
OSM9310-nA



OSM9310-nB



OSM9310-nC



The drawings show the OSM9310series; the OSB9310 and OSS9310series differ in the following respects:

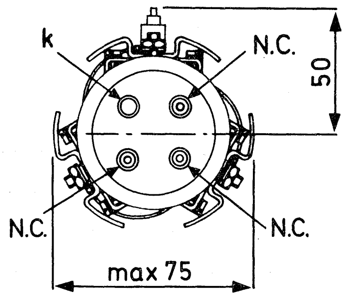
OSB9310series - terminals marked a(-) and k(+) in the drawings are both marked ∿; the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9310series - has no centre-tap.

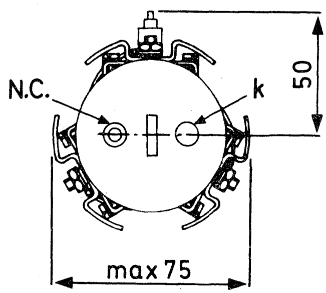
MECHANICAL DATA

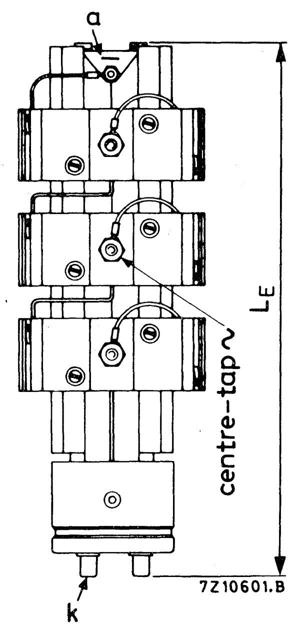
n = total number of diodes

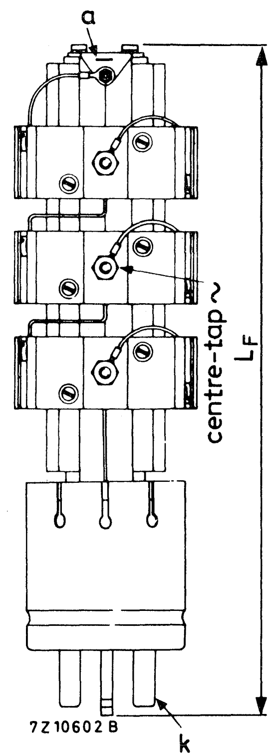
OSM9310-nE



OSM9310-nF





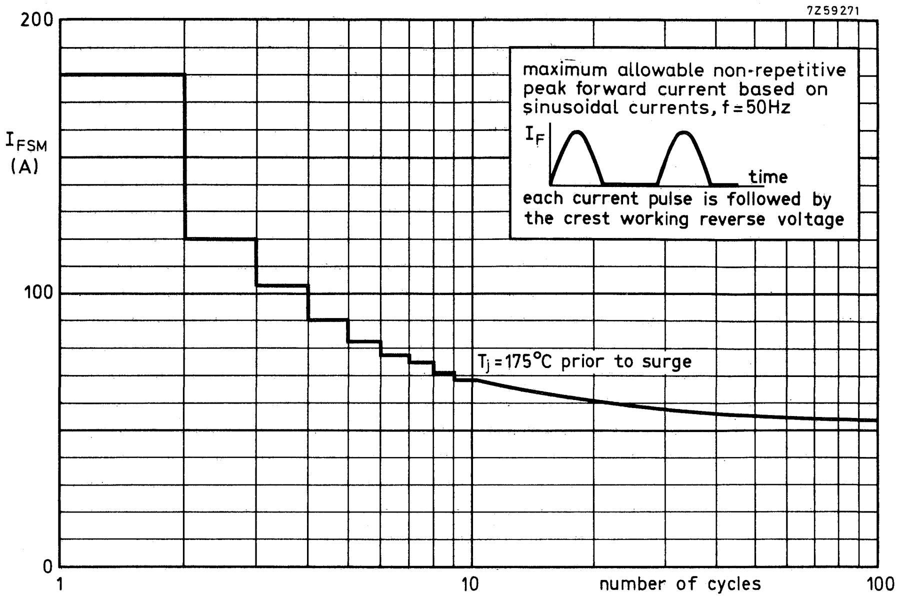


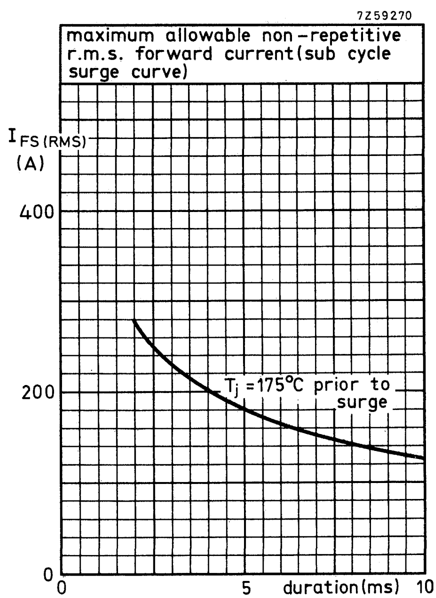
For lengths and weights see table on page 6.

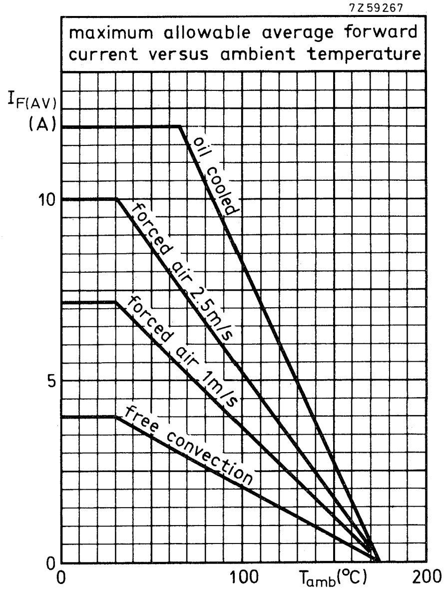
Table of lengths and weights (mm and g)

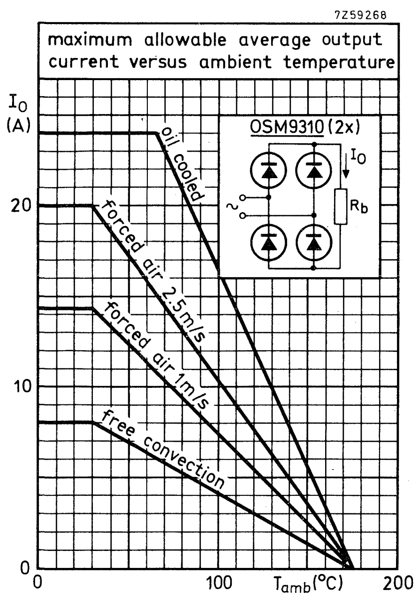
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weight	W_A	153	286	419	552	685
	$W_B = W_C = W_E$	218	351	484	617	750
	W_F	379	512	645	778	911

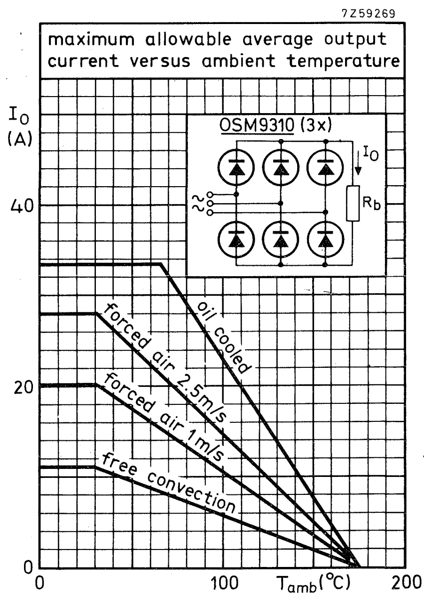
number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1084	1217	1350
	$W_B = W_C = W_E$	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z59271
maximum allowable non-repetitive peak forward current based on sinusoidal currents, f = 50Hz
I_F
time
each current pulse is followed by the crest working reverse voltage
I_FSM (A)
200
100
0
1
10
number of cycles
100
Tj = 175°C prior to surge


7Z59270
maximum allowable non-repetitive r.m.s. forward current (sub cycle surge curve)
I_FS (RMS) (A)
400
200
0
0
5
duration (ms)
10
Tj = 175°C prior to surge

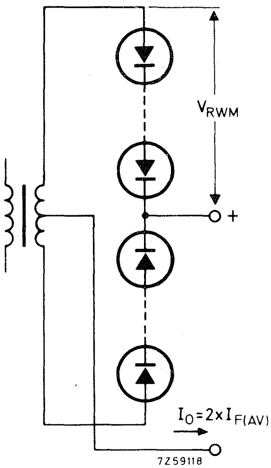

7Z59267
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
10
5
0
0
100
T_{amb} (°C)
200
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection


7Z59268
maximum allowable average output current versus ambient temperature
I_O (A)
20
10
0
0
100
T_{amb} (°C)
200
OSM9310 (2x)
I_O
R_b
~
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

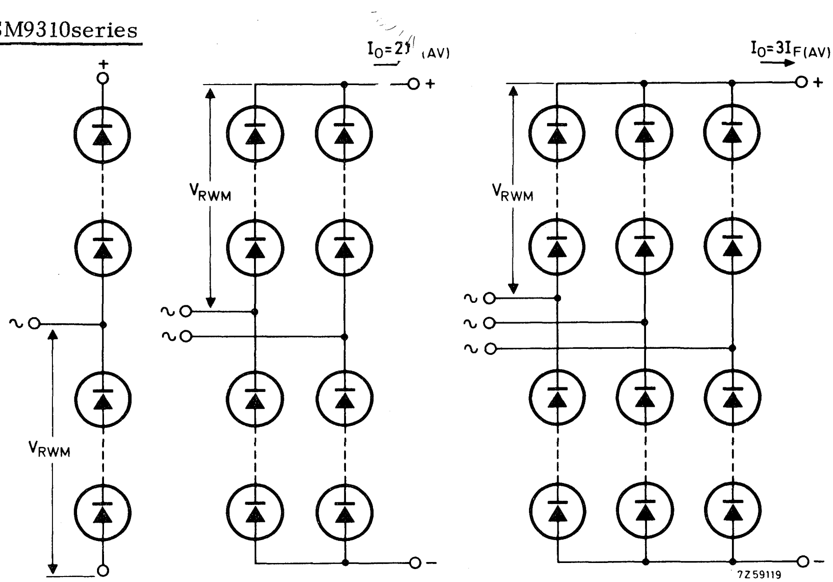

7Z59269
maximum allowable average output current versus ambient temperature
I_O (A)
40
20
0
0
100
T_{amb} (°C)
200
OSM9310 (3x)
I_O
R_b
≈
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

APPLICATION INFORMATION

OSB9310-4



OSM9310series



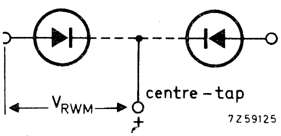
voltage doubler
1x OSM9310

rectifier circuits with respectively
2x OSM9310 and 3x OSM9310

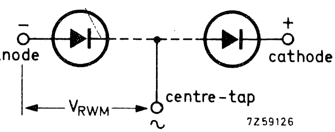
HIGH VOLTAGE RECTIFIER STACKS

The OSB9410, OSM9410 and OSS9410series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire prooftriangular formers. The OSB9410series is intended for application in two phase half wave rectifier circuits. The OSM9410series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9410series is intended for all kinds of highvoltage rectification. The assemblies are supplied with 1/4 "UNF studs. The OSB9410-series and OSM9410series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9410 and OSM9410series cover the range from 2 kV to 15 kV, and of the OSS9410series the range from 3 kV to 30 kV, in 1 kV steps.

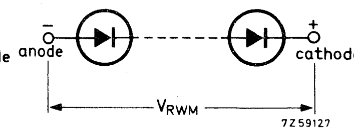
CIRCUIT OSB9410



CIRCUIT OSM9410



CIRCUIT OSS9410



QUICK REFERENCE DATA

		OSB9410	–4	–6	...	–28	–30	
		OSM9410	–4	–6	...	–28	–30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3		14	15	kV
		OSS9410	–3	–4	...	–29	–30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Average forward current with R and L load (averaged over any 20 ms period)

in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	10 A
in oil up to T_{oil} = 35 °C	$I_{F(AV)}$	max.	30 A

Non-repetitive peak forward current

t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	800 A

All information applies to frequencies up to 400 Hz

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

Voltages

		OSB9410	−4	−6	...	−28	−30	
		OSM9410	−4	−6		−28	−30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9410	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period) in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	10	A
in oil up to T_{oil} = 35 °C	$I_{F(AV)}$	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	800	A

Reverse power dissipation

		OSB9410	−4	−6	...	−28	−30	
		OSM9410	−4	−6	...	−28	−30	
Repetitive peak reverse power t = 10 μs (square wave: f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	9	13.5	...	63	67.5	kW
Non-repetitive peak reverse power t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	55	80	...	375	400	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	8.5	13	...	60.5	65	kW
		OSS9410	−3	−4	...	−29	−30	
Repetitive peak reverse power dissipation t = 10 μs (square wave: f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	13.5	18	...	130.5	135	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	80	10,5	...	775	800	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	13	17	...	126	130	kW

Temperatures

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

CHARACTERISTICS (See note 1)

			OSB9410 -4	-6	...	-28	-30	
Forward voltage			OSM9410 -4	-6	...	-28	-30	
I_F = 150 A; T_j = 25 °C	V_F	<	3.6	5.4	...	25.2	27	V
Reverse avalanche breakdown voltage [1)]		>	2.5	3.75	...	17.5	18.75	kV
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	<	4	6	...	28	30	kV

			OSS9410 -3	-4	...	-29	-30	
Forward voltage								
I_F = 150 A; T_j = 25°C	V_F	<	5.4	7.2	...	52.2	54	V
Reverse avalanche breakdown voltage [1)]		>	3.75	5	...	36.25	37.5	kV
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	<	6	8		58	60	kV

Reverse current

$V_{RM} = V_{RWMmax}$; T_j = 125 °C $\qquad I_{RM}$ < 1.6 mA

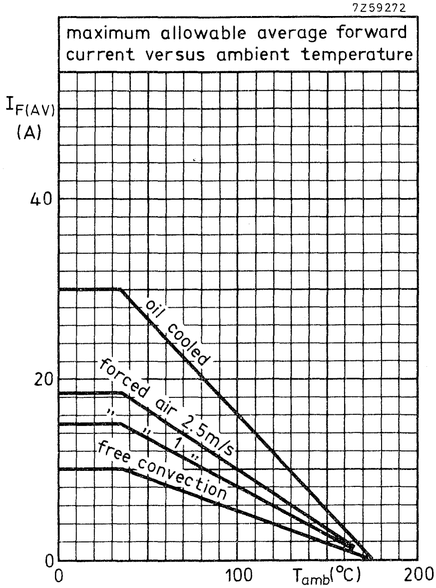
NOTES

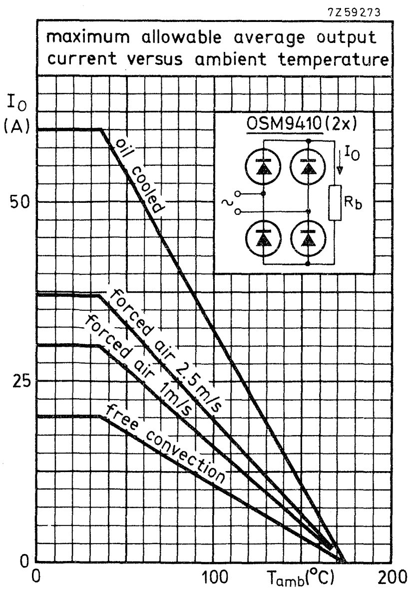
1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9410series)

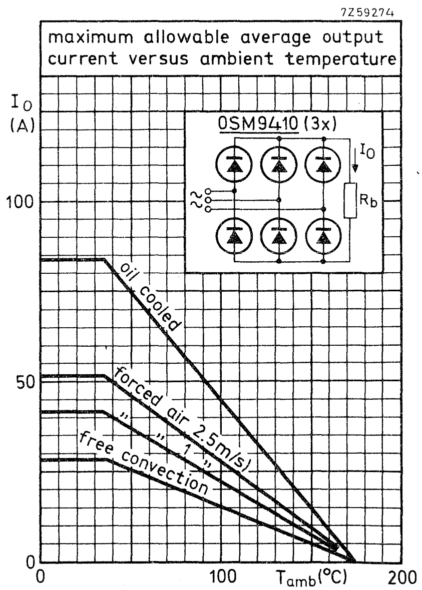
2. Type number suffix
   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = 1/4 "U.N.F. studs at the ends.

3. Operating position
   The rectifier units can be operated at their maximum ratings when mounted in any position.

1) The breakdown voltage increases, by approximately 0.1% per °C with increasing junction temperature.

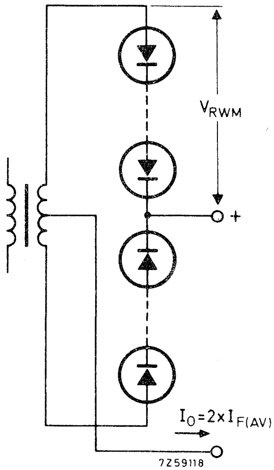

7Z59272
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
40
20
0
oil cooled
forced air 2.5m/s
" " 1 "
free convection
0
100
T_{amb}(°C)
200


7Z59273
maximum allowable average output current versus ambient temperature
I_O (A)
50
25
0
OSM9410 (2x)
I_O
R_b
~
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection
0
100
T_{amb}(°C)
200

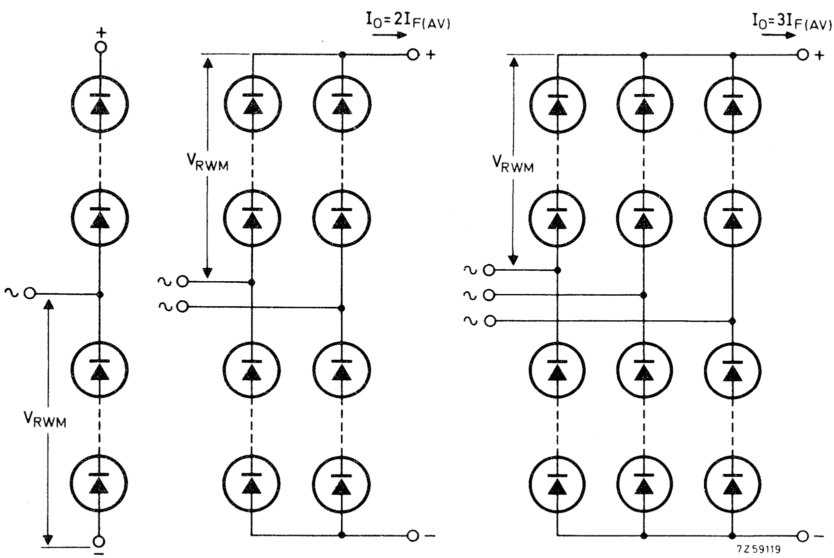

7Z59274
maximum allowable average output current versus ambient temperature
I_O (A)
100
50
0
OSM9410 (3x)
I_O
R_b
oil cooled
forced air 2.5m/s
" " 1 "
free convection
0
100
T_{amb}(°C)
200

APPLICATION INFORMATION

OSB9410 -4



OSM9410series



voltage doubler
1x OSM9410

rectifier circuits with respectively
2x OSM9410 and 3x OSM9410

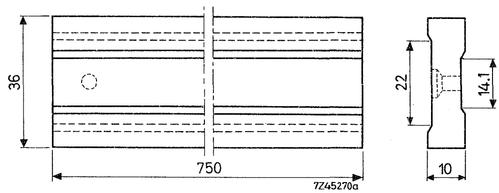
Accessories

MOUNTING STRIPS

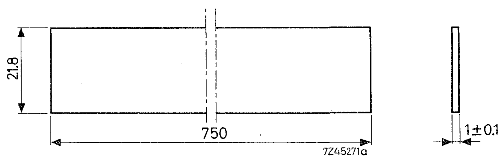
Type 56233 consists of the following components (1 to 2) Dimensions in mm

1.
 1 mounting strip of insulating material

 Weight with cover: 330 g



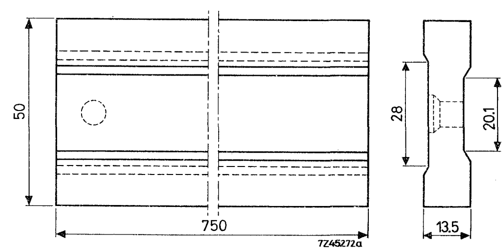
2.
 1 insulating plate



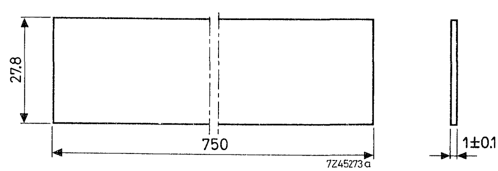
Type 56234 consists of the following components (1 to 2) Dimensions in mm

1.
 1 mounting strip of insulating material

 Weight with cover: 615 g



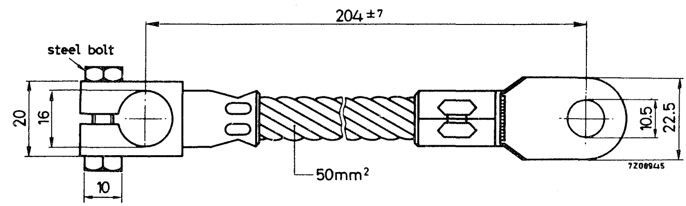
2.
 1 insulating plate



FLEXIBLE TOP LEADS

56243

MECHANICAL DATA Dimensions in mm

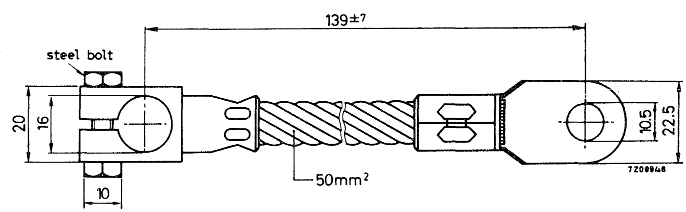


Weight: 170 g

Top lead 56243 should be used only for $I_{F\,(RMS)} \leq 400$ A.

56243A

MECHANICAL DATA Dimensions in mm



Weight: 140 g

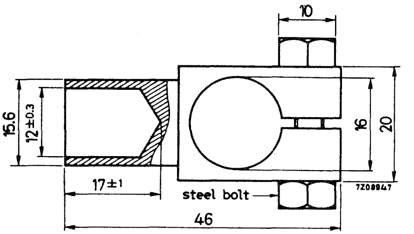
For $I_{F\,(RMS)} > 400$ A, top lead 56243A must be used.
This prevents the temperature of the top connection becoming too high.

CLAMP

56244

MECHANICAL DATA

Dimensions in mm



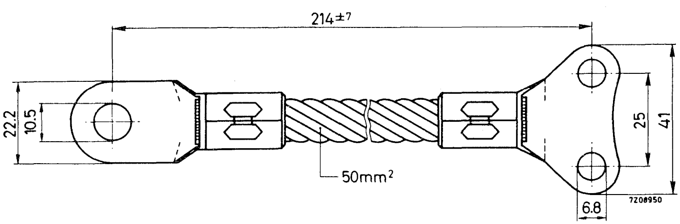
MOUNTING INSTRUCTIONS

The steel bolt ensures that sufficient torque can be applied to obtain good electrical contact.

56247 FLEXIBLE BASE LEAD

MECHANICAL DATA

Dimensions in mm

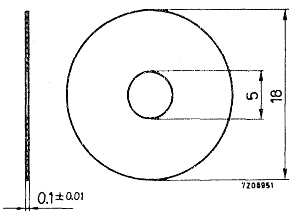


Weight: 130 g

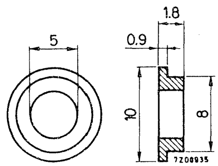
MOUNTING ACCESSORIES

MECHANICAL DATA

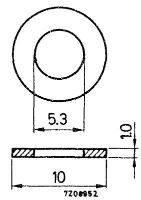
Dimensions in mm



mica washer



insulating ring



plain washer
material: brass, nickel plated

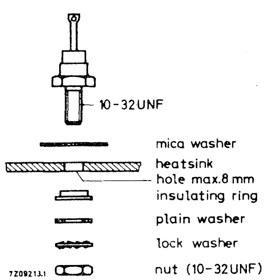
THERMAL RESISTANCE

From mounting base to heatsink (with mica washer) $R_{th\ mb\text{-}h}$ = 5 °C/W

TEMPERATURE

Maximum allowable temperature T_{max} = 125 °C

MOUNTING INSTRUCTIONS

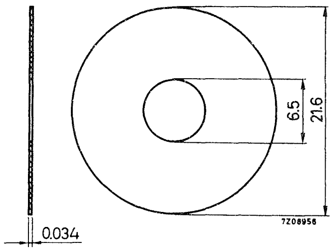


Notes: When using a tag for electrical contact insert tag between nut and plain washer or replace plain washer by tag.

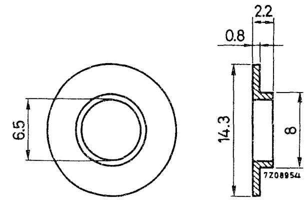
MOUNTING ACCESSORIES

MECHANICAL DATA

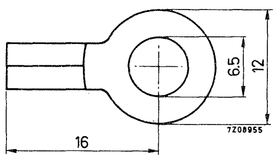
Dimensions in mm



Mica washer



Insulating ring



Soldering tag

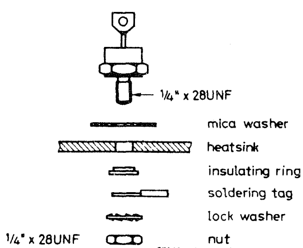
THERMAL RESISTANCE

From mounting base to heatsink
with mica washer $R_{th\ mb-h}$ = 4 °C/W

TEMPERATURE

Maximum allowable temperature T_{max} = 175 °C

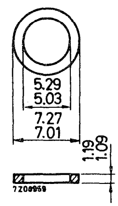
MOUNTING INSTRUCTIONS



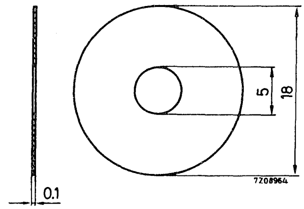
MOUNTING ACCESSORIES

MECHANICAL DATA

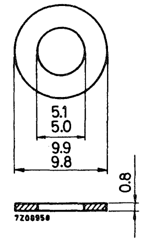
Dimensions in mm



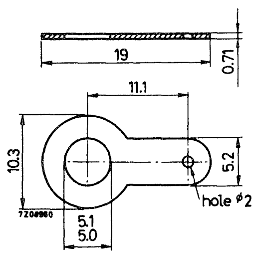
PTFE bush



2 mica washers



plain washer



terminal tag

THERMAL RESISTANCE

From mounting base to heatsink

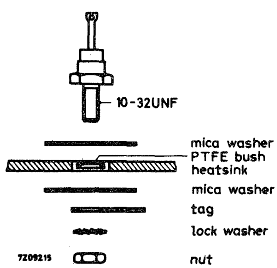
$R_{th\ mb\text{-}h} = 5\ ^{o}C/W$

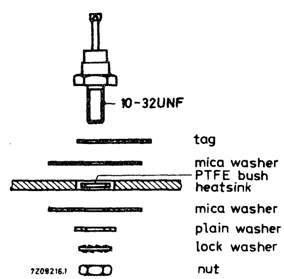
TEMPERATURE

Maximum allowable temperature

$T_{max} = 175\ ^{o}C$

MOUNTING INSTRUCTIONS



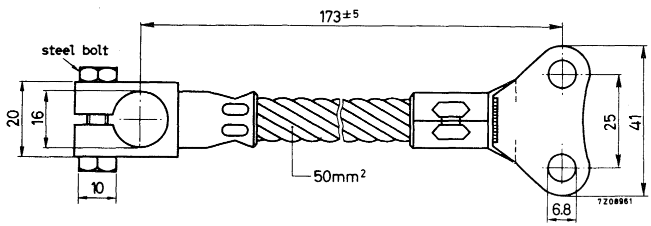


FLEXIBLE LEAD FOR SERIES CONNECTION

56296

MECHANICAL DATA

Dimensions in mm

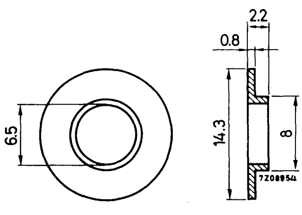


INSULATING RING

56299

MECHANICAL DATA

Dimensions in mm



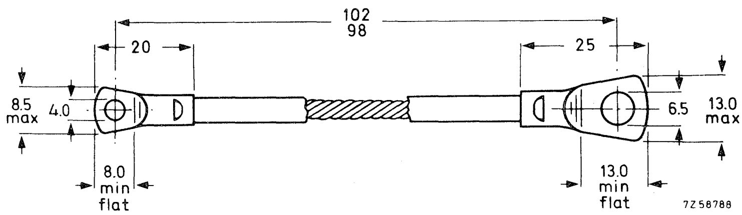
Accessory 56299 is the insulating ring of 56264A.

Maximum operating temperature T_{max} = 175 °C

EXTERNAL LEAD

MECHANICAL DATA

Dimensions in mm

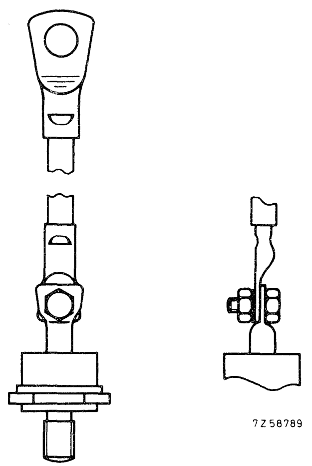


Net weight: 12 g

56309B: External anode lead (blue lead)

56309R: External cathode lead (red lead)

MOUNTING METHOD



Heatsinks

General
Flat heatsinks
Diecast heatsinks
Heatsink extrusions
Water cooled heatsink

INTRODUCTION

Semiconductor rectifier diodes, thyristors and zener diodes for medium and high power have power losses which cannot be sufficiently transferred to the ambient air by these devices themselves. To prevent excessive junction temperatures the heat transfer capacity has to be improved.
This is achieved by heatsinks, which transfer the dissipated heat from the semiconductor junction to the ambient air by convection and radiation.

A flat metal plate is the simplest form of a heat transfer medium, but it is not the most efficient form for all conditions. In most cases a more complex form of heatsink will have advantages with regard to cost, size and weight.

This chapter offers, apart from information on heat transfer and the mechanical construction of assemblies, useful indications on how to take advantage of reverse-polarity diodes, etc., and, finally, the technical data on three types of heatsink with examples of calculation.

HEAT TRANSFER PATH

In a silicon rectifier the heat is generated inside the silicon wafer. From there the heat flows mainly to the base of the device and then via the heatsink to the surrounding air. The heat flow through heat conductors is analogous to the flow of electric current through electrical conductors. In this analogy the thermal resistance (R_{th} in $^{o}C/W$) corresponds with the electrical resistance (R in Ω).

Fig.1 shows the heat path from the junction to the ambient air as a series connection of three thermal resistances:

$R_{th\ j\text{-}mb}$: The thermal resistance from junction to mounting base. Its value can be found in the data sheets of the relevant semiconductor device.

$R_{th\ mb\text{-}h}$: The contact thermal resistance. This is the thermal resistance from mounting base to heatsink, resulting from the contact area being limited and the contact itself being imperfect. Its value can also be found in the data sheets.

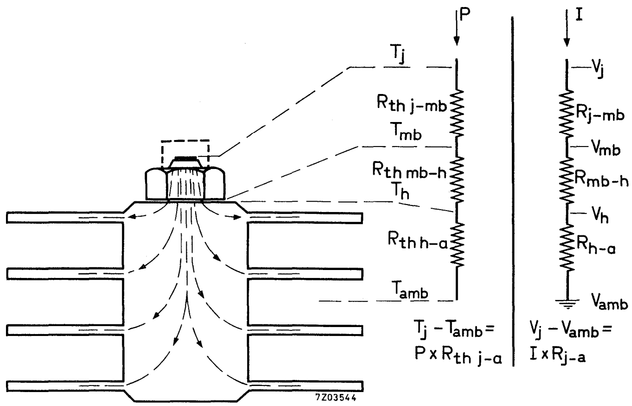
$R_{th\ h\text{-}a}$: The thermal resistance of the heatsink. This is the thermal resistance between the contact surface and the ambient air.

Once the heat has been transferred from heatsink to ambient, cool air must replace the heated air.

According to fig.1 the following formula can be used in heatsink calculations:

$$T_j - T_{amb} = P \times (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a})$$

Fig.1 Analogy between heat conduction and electric conduction



MEANS TO IMPROVE HEAT TRANSFER

The contact thermal resistance can be made as small as possible by using:

1. a large contact area
2. plane contact surfaces by proper machining, grinding, etc. Heatsinks should be blanked or made burr-free after punching or drilling holes
3. sufficient pressure by applying at least the rated minimum torque. Use a torque spanner
4. silicon grease to fill up air pockets. A thin layer of air has a much higher resistance to heat flow than a thin film of grease (e.g. Dow Corning 340)

The thermal resistance of the heatsink can be reduced by:

1. painting or anodising the surface, which improves heat transfer by radiation
2. higher speed of the cooling air
3. larger size of the heatsink

The air flow can be obtained in the simplest way by natural convection. Any obstruction should be avoided. Therefore fins should be placed vertically, air intake and outlet apertures should be as large as possible. Ample spacing between heatsinks and adjacent structures and provisions to obtain a chimney effect also improve the air flow.

If free convection is not sufficient to remove the heat, a blower or a fan must be used. Forced air cooling also permits a substantially smaller heatsink.

INSULATED MOUNTING

In bridge rectifiers it may be desirable to insulate a diode electrically from its heatsink by means of a mica or teflon wahser. As a consequence the contact thermal resistance will be about 10 times that of the case without insulation. Since the total thermal resistance has a fixed maximum value for given values of P and T_{amb} (see previous section), the increase of $R_{th\ mb\text{-}h}$ has to be compensated by a considerable reduction of $R_{th\ h\text{-}a}$ (e.g. by using a much larger heatsink).

Furthermore, the creepage distances along the insulator may be too small for the high voltages occurring between diode and heatsink. In fig.2 the creepage distances A and B can be made sufficiently large; but C and D will always be small.

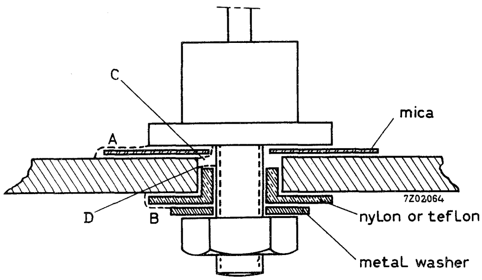


Fig.2 Creepage distances at an insulated diode
(C and D are the critical ones)

CONSTRUCTION OF ASSEMBLIES

In the previous sections some details have been given regarding the proper way of connecting a diode to a heatsink, positioning of heatsinks, etc.

For better current sharing of parallel-connected diodes a good thermal coupling of the devices is needed, which reduces differences in the forward characteristics. Two series-connected diodes should have a good thermal coupling in view of the reverse characteristics.

Thermal coupling can be obtained by mounting two diodes on one heatsink. On a plain cooling fin the two diodes should be mounted according to fig.3, on an extruded aluminium heatsink according to fig.4. A distance between the two diodes equal to one third of the heatsink length provides sufficient thermal coupling. For the electrical connection it is preferred to use a copper strip with a thickness of 1 mm. Mounting two diodes on one heatsink also saves mounting cost.

A flat plate with two diodes should have twice the area necessary for a separately mounted diode.
An extruded aluminium heatsink with two diodes should have twice the length necessary for a separately mounted diode.

An electrical series connection of two diodes mounted on one heatsink can be obtained by using diodes of different polarity. Figs. 5, 6, 7 and 8 show how the combination of normal and reverse-polarity diodes simplifies the assembly of single phase and three phase bridge rectifiers.

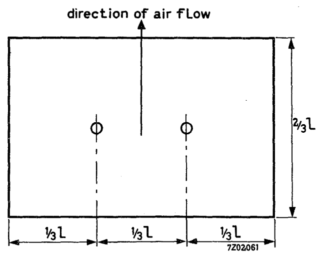


Fig.3. Dimensioning of a plain cooling fin with two diodes

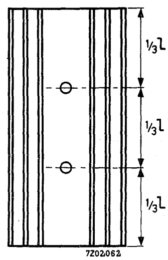


Fig.4. Extruded aluminium heatsink with two diodes

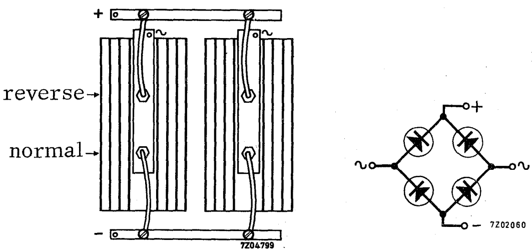


Fig.5. Single phase full wave rectifier with diodes of different polarity on extruded aluminium heatsinks

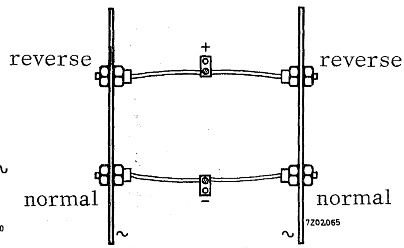


Fig.6. Single phase full wave rectifier with diodes of different polarity on plain cooling fins (Top view)

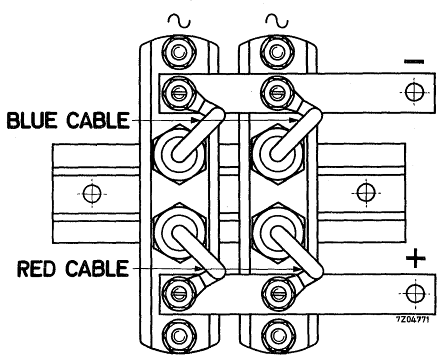


Fig.7. Single phase full wave rectifier with diodes of different polarity (red cable: reverse polarity; blue cable: normal polarity) on two double heatsinks 56250

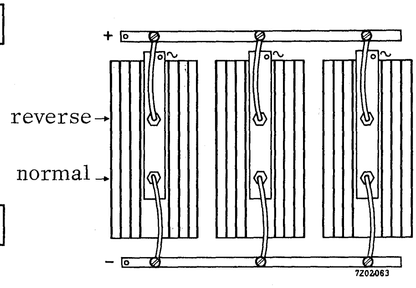
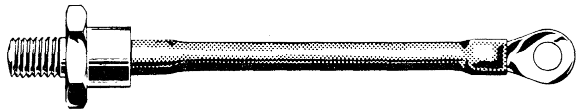


Fig.8. Three phase full wave rectifier with diodes of different polarity on extruded aluminium heatsinks

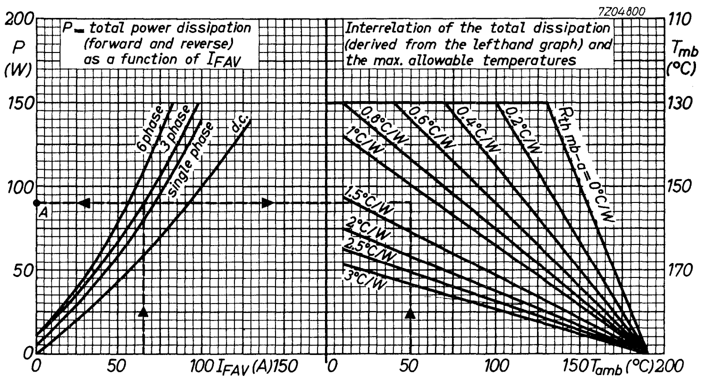
EXAMPLES OF HEATSINK CALCULATION

1. Devices without controlled avalanche properties.
Assume that the diode of which the outlines are shown, is used in a three phase 50 Hz rectifier circuit at T_{amb} = 50 °C. Further assume: average forward current per diode I_{FAV} = 65 A; contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.1 °C/W



Stud: M12
Mounting base, across the flats: max. 27 mm

From the data of the diode the graph to be used is shown below.



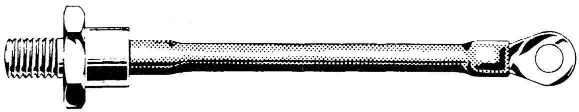
From the lefthand graph it follows that P_{tot} = 90 W per diode (point A).
From the righthand graph it follows that $R_{th\ mb\text{-}a} \approx$ 1.2 °C/W.
Thus $R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}$ = (1.2 - 0.1) °C/W = 1.1 °C/W.
This may be achieved by different types of heatsinks as shown below.

Type	Free convection	Forced cooling
flat, blackened	–	125 cm^2; 2 m/s or 300 cm^2; 1 m/s
bright	–	175 cm^2; 2 m/s
diecast 56274	–	≈ 1.5 m/s
56280	applicable	
extrusion		
56230 bright	l = 12 cm	l = 5 cm 1); 1 m/s
blackened	l = 8 cm	l = 5 cm 1); 1 m/s
56231 bright	l = 7 cm	
blackened	l = 5 cm 1)	

1) Practical minimum length

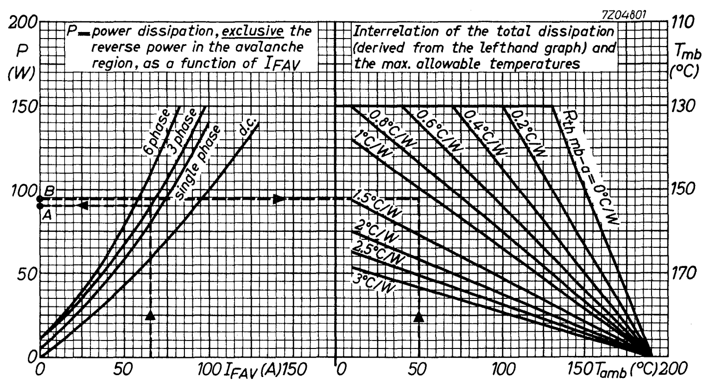
2. Devices with controlled avalanche proporties

Assume that the diode of which the outlines are shown, is used in a three phase 50 Hz rectifier circuit at T_{amb} = 50 ^oC. Further assume: average forward current per diode I_{FAV} = 65 A; contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.1 $^oC/W$; repetitive peak reverse power in the avalanche region (t = 10 μs) P_{RRM} = 8 kW (per diode).



Stud: M12
Mounting base, across the flats: max. 27 mm

From the data of this diode the graph to be used is shown below.



From the lefthand graph it follows that P_{tot} = 90 W per diode (point A).
The average reverse power in the avalanche region, averaged over any cycle, follows from $P_{RAV} = \delta \times P_{RRM}$, 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} = 90 + 4 = 94 W (point B).
From the righthand graph it follows that $R_{th\ mb\text{-}a} \approx 1.1\ ^oC/W$.
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (1.1 - 0.1)\ ^oC/W = 1\ ^oC/W.$$

A table of applicable heatsinks, similar to that on the foregoing page, can be derived for this case.

SELECTION GUIDE FOR DIODES

To simplify the selection of heatsinks, the table below indicates for each diecast heatsink the diodes for which is may be used.
For extruded heatsinks the most suitable combinations are given.
As an additional guide, the outlines of the appropriate diodes are shown beside the heatsink data.

	BYX38 BYX39 BYX50	BYX25 BYX30 BYX40 BYX42 BYX46 BYX48	BYX13	BYX52 BYX56	BYX34 BYX59	BYX23 BYX32	BYX27 BYX33 BYX51
Diecast 56250						●	
56268	●						
56271			●		●		
56274						●	
56277			●				
56278				●			
56280						●	
56283							●
Extrusions 56230 56231		●	●	●	●		
56290	●	●	●				
56293				●	●	●	●

SELECTION GUIDE FOR THYRISTORS

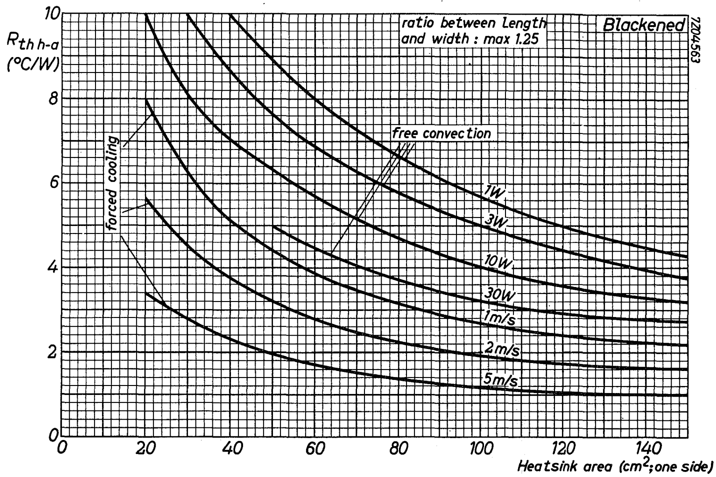
To simplify the selection of heatsinks, the table below indicates for each diecast heatsink the thyristors for which it may be used.
For extruded heatsinks the most suitable combinations are given.
As an additional guide, the outlines of the appropriate thyristors are shown beside the heatsink data.

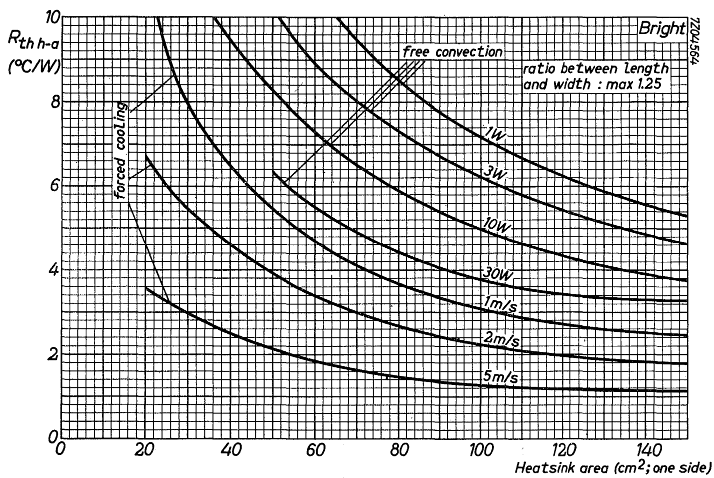
	BT101 BT102 BTX68 BTY79	BTX35 BTY87	BTX36 BTX47 BTX48 BTY91	BTX81 BTX82 BTX92 BTX94	BTX37 BTY95	BTX38 BTX49 BTX50 BTY99	BTX41
Diecast 56253		●	●	●			
56256	●						
56278			●	●			
56279					●	●	
56284							●
56286					●	●	
Extrusions 56230 56231		●	●	●	●	●	
56290	●	●	●	●			
56293					●	●	
Water cooled 56311							●

Flat heatsinks

Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

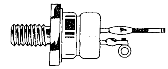
Studs: 10-32UNF
Mounting bases, across the flats: max. 11.0 mm



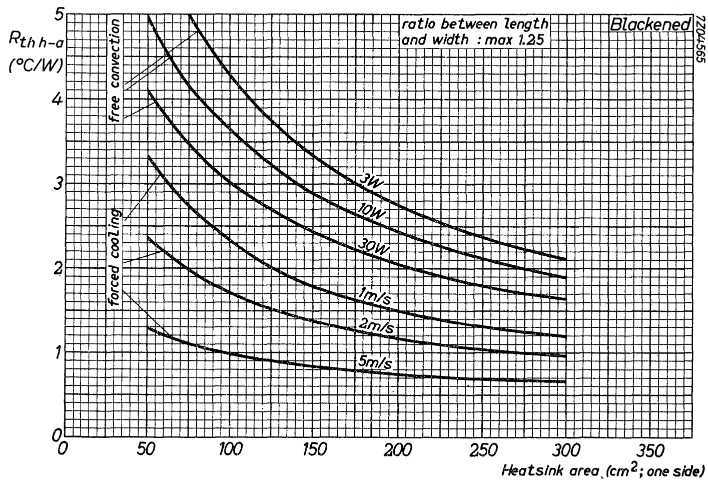


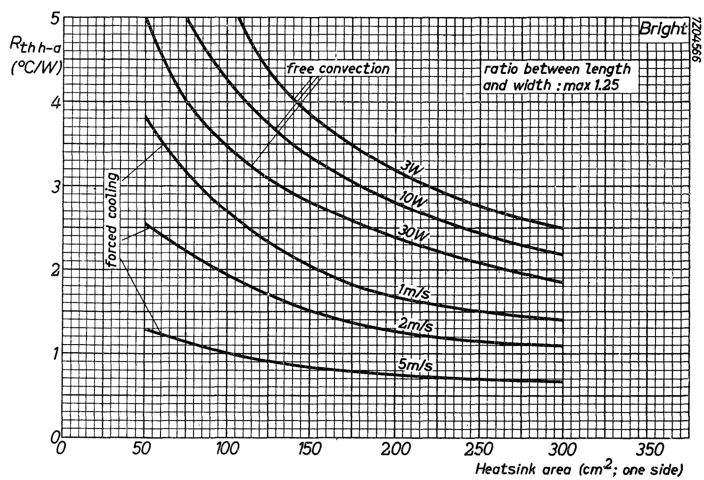
Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

Stud: M8
Mounting base, across the flats: max. 17 mm

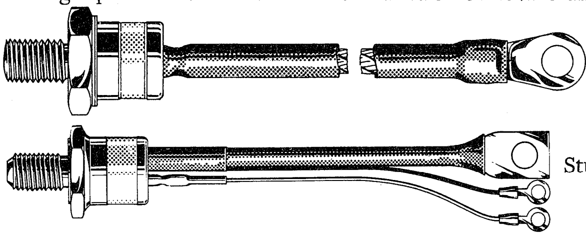


Stud: $\frac{1}{4}$" x 28 UNF
Mounting base, across the flats: max. 14.3 mm

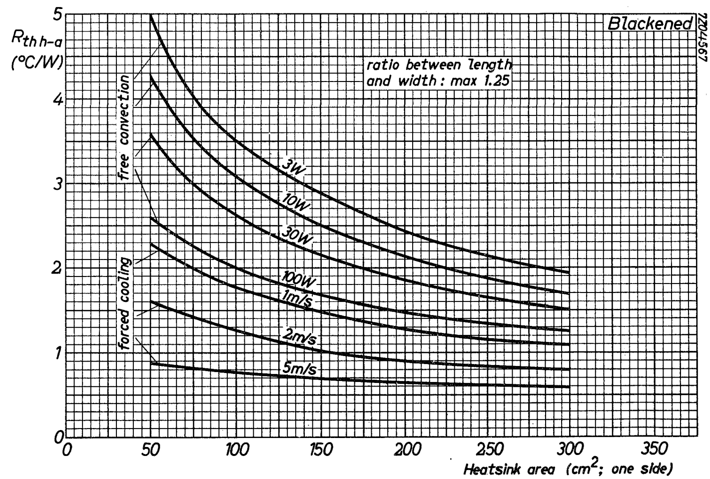


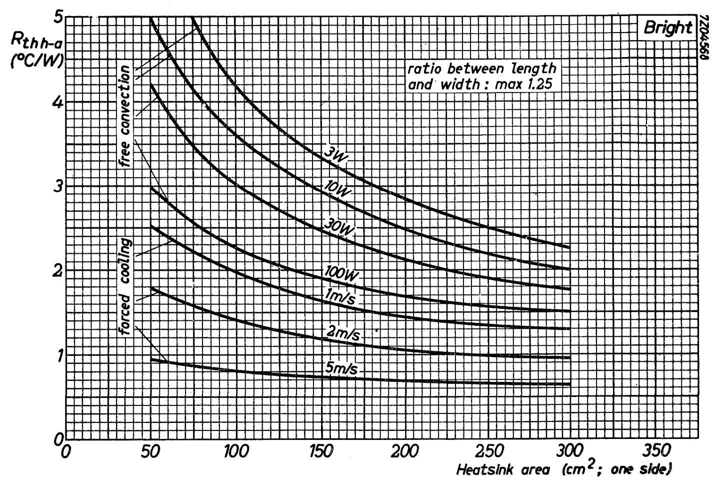


Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

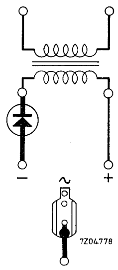
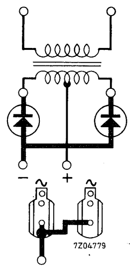
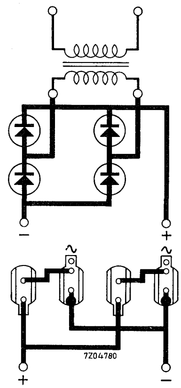
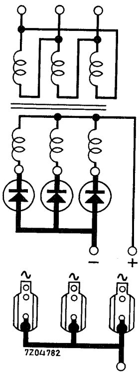


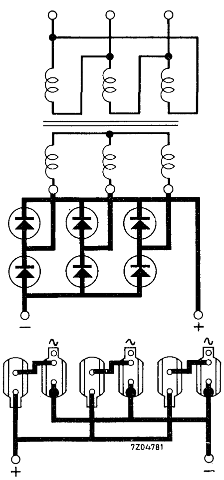
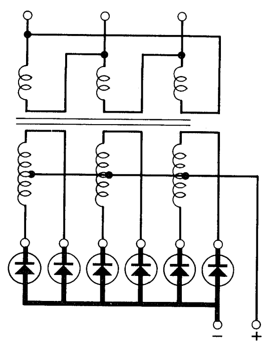
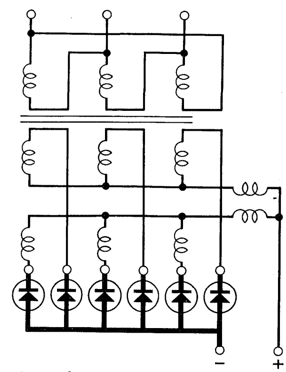
Studs: M12 or $\frac{1}{2}$" x 20UNF

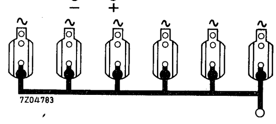


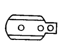


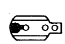
RECTIFIER CIRCUITS ON SINGLE HEATSINKS

Single phase half wave	Two phase half wave	Single phase full wave (Single phase bridge)	Three phase half wave (Three phase star)
			

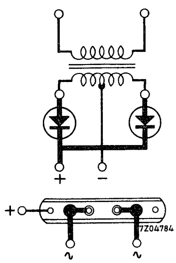
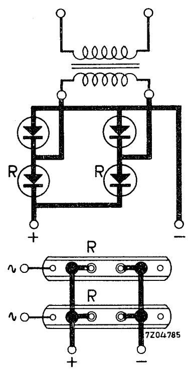
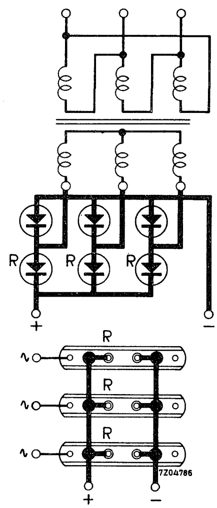
Three phase full wave (Three phase bridge)	Six phase half wave (Six phase star)	Three phase double Y with interphase transformer
		



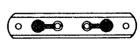
Diecast heatsink without insulator 

Diecast heatsink with insulator 

RECTIFIER CIRCUITS ON DOUBLE HEATSINKS

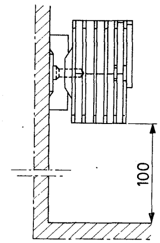
Two phase half wave	Single phase full wave (Single phase bridge)	Three phase full wave (Three phase bridge)
		

R = Reverse polarity diode

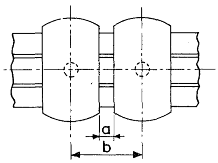
Diecast heatsink 56250 

MOUNTING INSTRUCTION FOR DIECAST HEATSINKS

1. At free convection cooling or forced air flow < 0.5 m/s the heatsinks should be mounted with the fins vertical and with a distance to the chassis bottom > 100 mm.

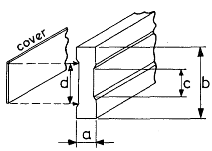


2. At forced air flow > 0.5 m/s the heatsinks may be mounted in any position.
3. Minimum distance between heatsinks in a row.



Heatsink	Distance (mm) a	b
56256/68	> 5.0	>25.0
56277	> 5.0	>40.0
56250/53	>10.0	>50.0
56271/74	>10.0	>50.0

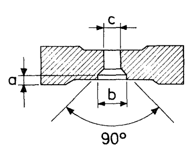
4. The rectifier devices should be fixed to their heatsinks with the torques specified in the relevant published data. Use a torque spanner.
5. For insulated mounting of heatsinks two sizes of mounting strips made of insulating material are available.



Strip	Dimensions (mm) a	b	c	d	Weight (g) (with cover)
56233	10.0	36	14.1	22	330
56234	13.5	50	20.1	28	615

Length 750 mm

6. Mounting holes to be made in the strips:

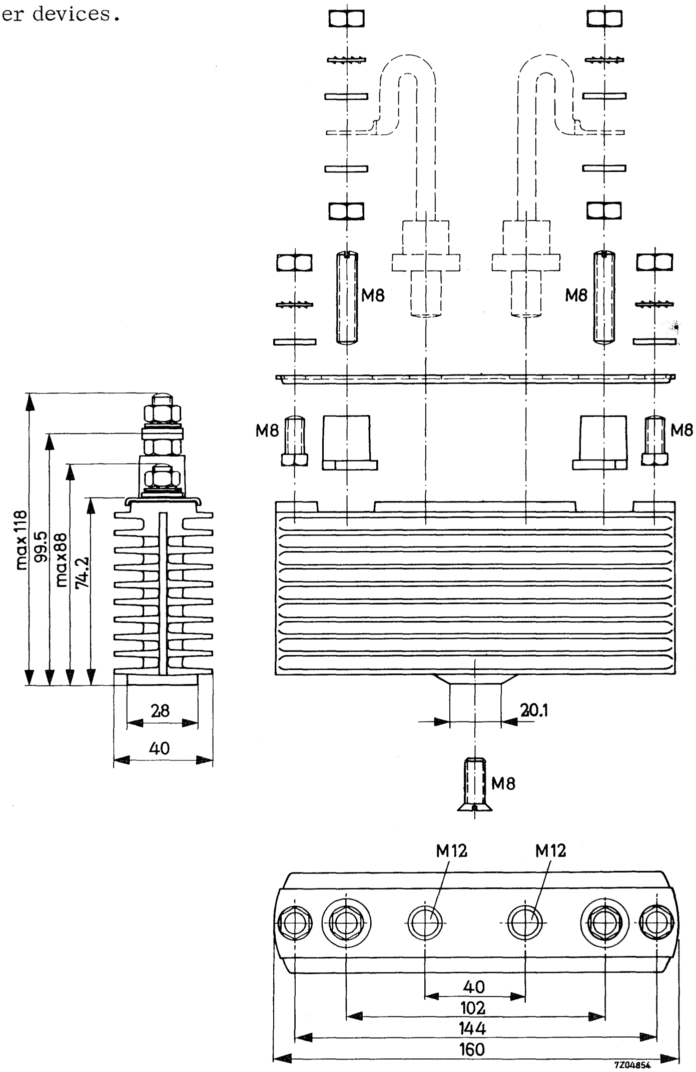


Heatsink	Strip	Dimensions in mm a	b	c
56256/68	56233	< 1.5	7.5	4.3
56253/71	56234	< 1.3	10.2	6.3
56274/77	56234	< 1.3	10.2	6.3
56250	56234	< 1.8	13.8	8.3

DIECAST HEATSINK FOR TWO DEVICES

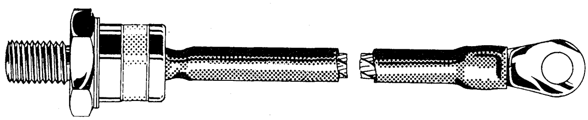
Diecast heatsink of aluminium alloy, painted black, with two M12 tap holes for two rectifier devices.

Dimensions in mm

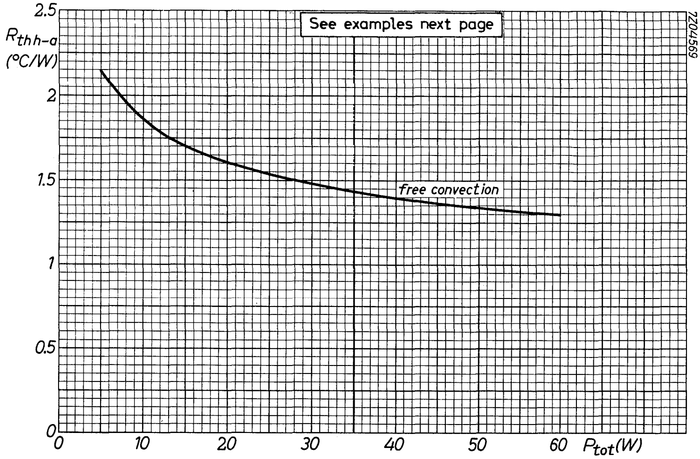


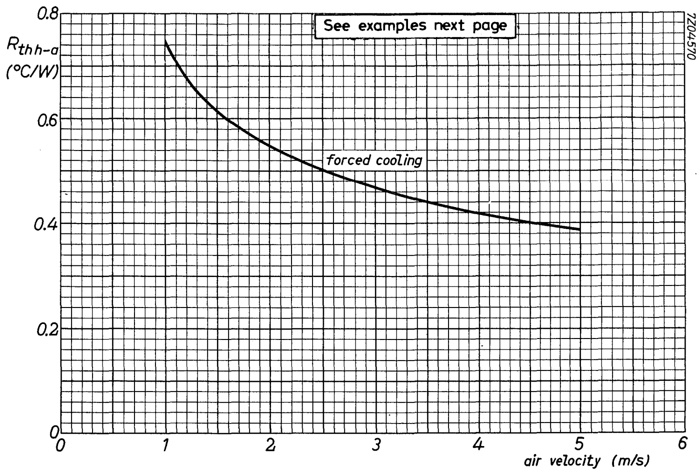
Weight 730 g

The graphs are valid for the combination of device and heatsink.



Stud: M12
Mounting base, across the flats: 27.0 mm





Calculations for the double heatsink 56250

For equal devices at equal conditions the maximum allowable mounting base temperature shall be calculated. After subtraction of the temperature drop caused by the contact thermal resistance the required heatsink thermal resistance can be determined.

For two different devices (with different $T_{j\ max}$, power dissipation and contact thermal resistance) the lower of the two maximum allowable mounting base temperatures shall be taken, after which the same procedure is followed.

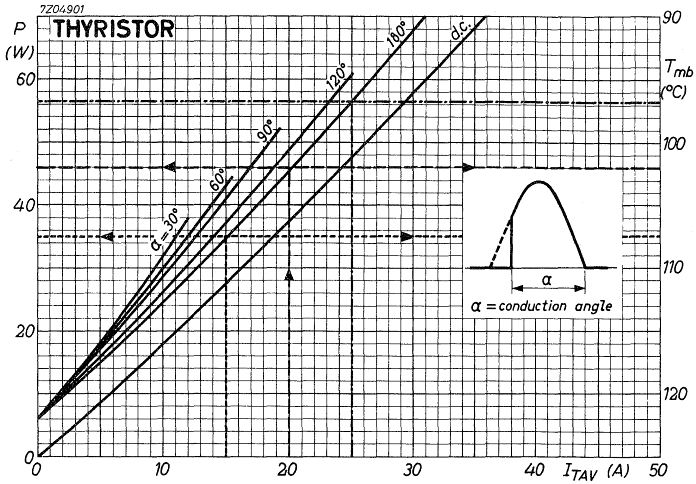
Examples

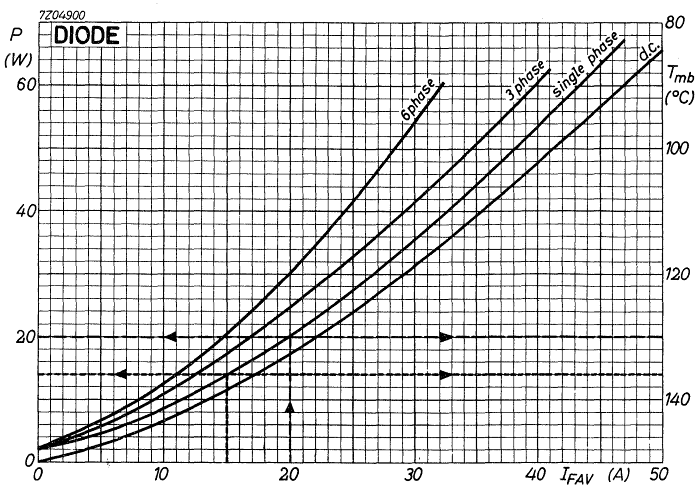
Consider a thyristor T and a diode D, used in single phase application ($\alpha = 180^{o}$), of which the curves to be used are shown on the next page. For all examples the contact thermal resistance $R_{th\ mb\text{-}h} = 0.1\ ^{o}C/W$.
In the table below, three different examples have been worked out.

	$T_1 + D_2$	$T_1 + D_2$	$T_1 + T_2$
Given: T_{amb} I_{AV}	30 ^{o}C 15 A	50 ^{o}C 20 A	45 ^{o}C 25 A
From next page			
P_1	35 W	46 W	56.5 W
P_2	14 W	20 W	56.5 W
$P_{tot} = P_1 + P_2$	49 W	66 W	113 W
$T_{mb\ 1}$ max.	107.5 ^{o}C	102 ^{o}C	96.5 ^{o}C
$T_{mb\ 2}$ max.	136 ^{o}C	130 ^{o}C	96.5 ^{o}C
$P_1 \times R_{th\ mb\text{-}h} = \Delta T_{mb\text{-}h}$	3.5 ^{o}C	4.6 ^{o}C	5.7 ^{o}C
Maximum T_h	104 ^{o}C	97.4 ^{o}C	90.8 ^{o}C
T_{amb}	30 ^{o}C	50 ^{o}C	45 ^{o}C
Max. $\Delta T_{h\text{-}a}$	74 ^{o}C	47.4 ^{o}C	45.8 ^{o}C
$\frac{\text{Max. } \Delta T_{h\text{-}a}}{P_{tot}} =$	$\frac{74}{49} =$	$\frac{47.4}{66} =$	$\frac{45.8}{113} =$
Max. $R_{th\ h\text{-}a}$	1.5 $^{o}C/W$	0.72 $^{o}C/W$	0.4 $^{o}C/W$
From graphs on foregoing page follows:	Possible with free convection. 50 W: 1.35 $^{o}C/W$	Only with forced cooling. At least 1.1 m/s	Only with forced cooling. At least 4.5 m/s

Calculations for the double heatsink 56250 (continued)

The two graphs below give the power dissipation and the maximum allowable mounting base temperature versus the average forward current, for the thyristor T and the diode D, respectively.

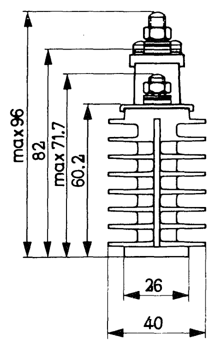


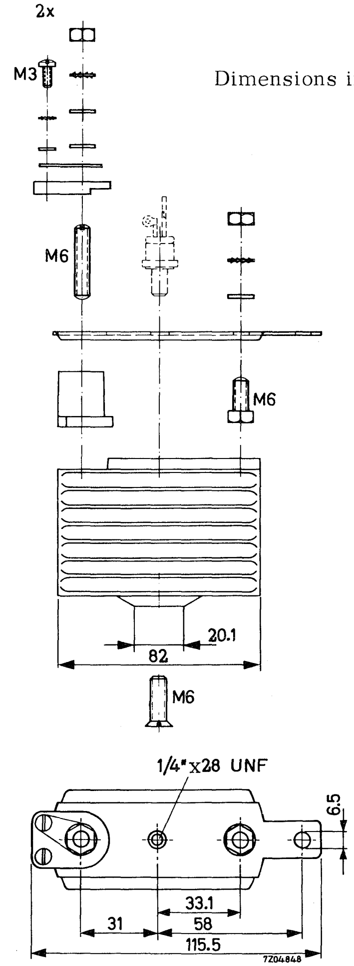


DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with 1/4"x28 UNF tap hole for rectifier device.

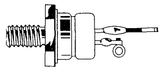
Dimensions in mm



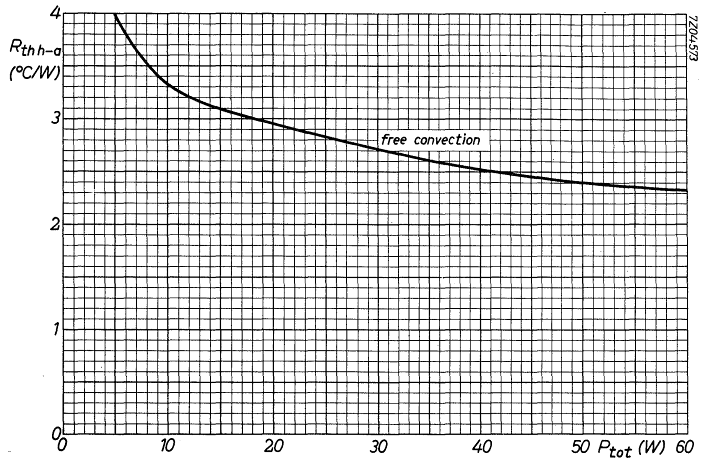


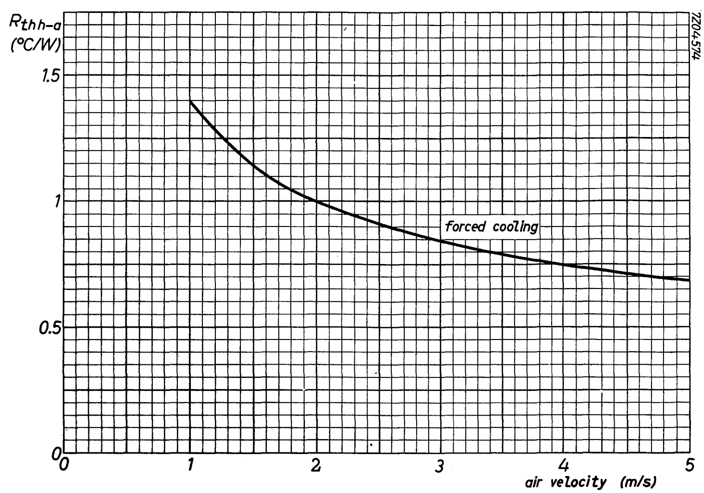
Weight 305 g

The graphs are valid for the combination of thyristor and heatsink.



Stud: $\frac{1}{4}$" x 28UNF
Mounting base, across the flats: max. 14.0 mm



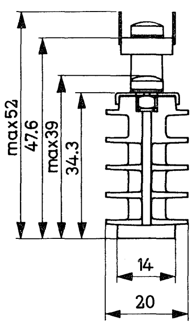


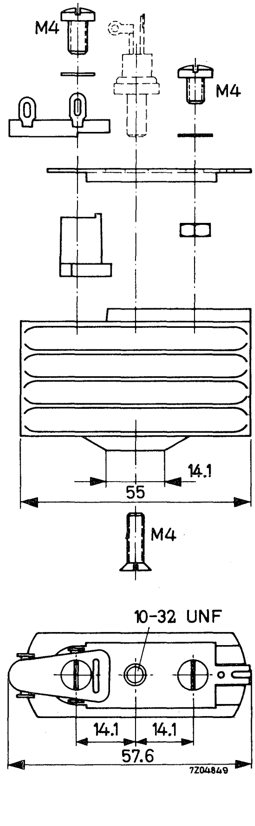
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with 10-32 UNF tap hole for rectifier device.

Dimensions in mm

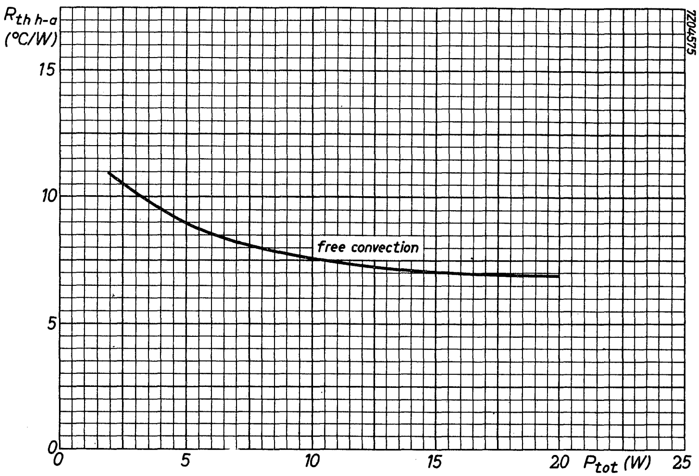
Weight: 55 g

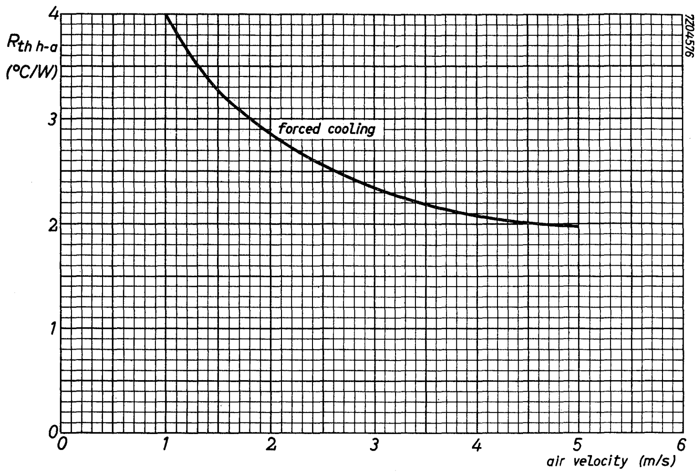




The graphs are valid for the combination of thyristor and heatsink.

Stud: 10 - 32UNF
Mounting base, across the flats: 11.0 mm



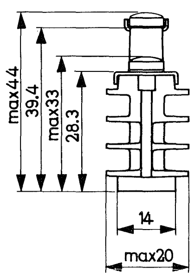


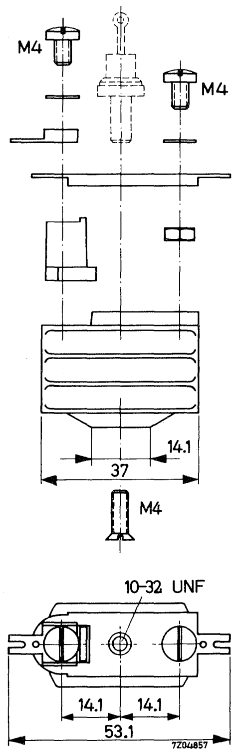
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with 10-32 UNF tap hole for rectifier device.

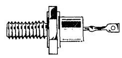
Dimensions in mm

Weight 33 g

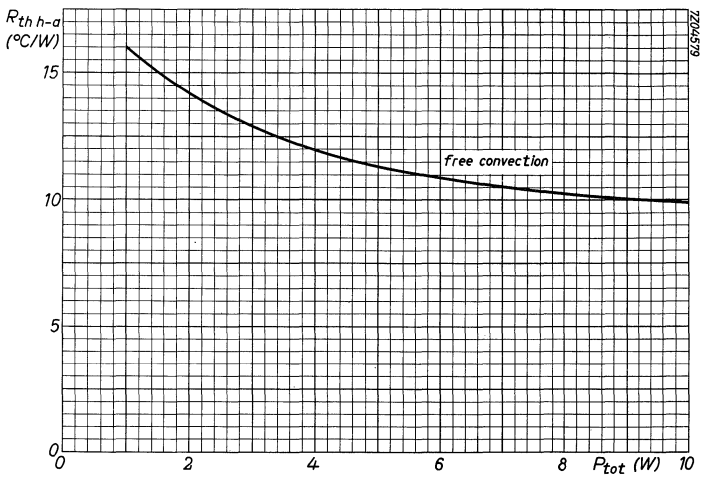


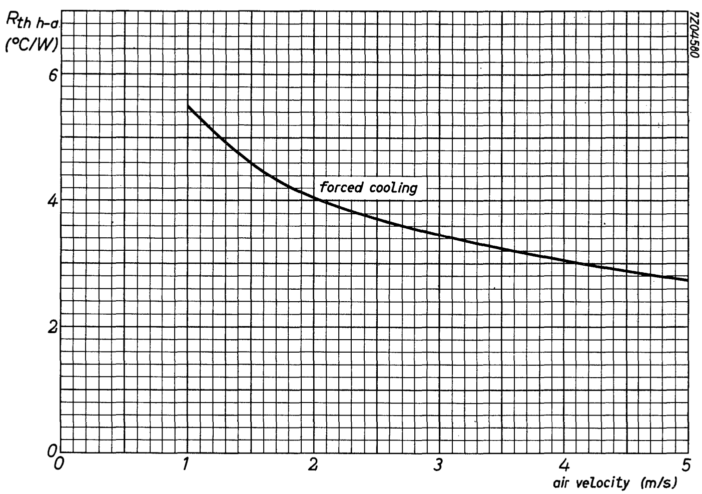


The graphs are valid for the combination of diode and heatsink.



Stud: 10 - 32UNF
Mounting base, across the flats: 11.0 mm



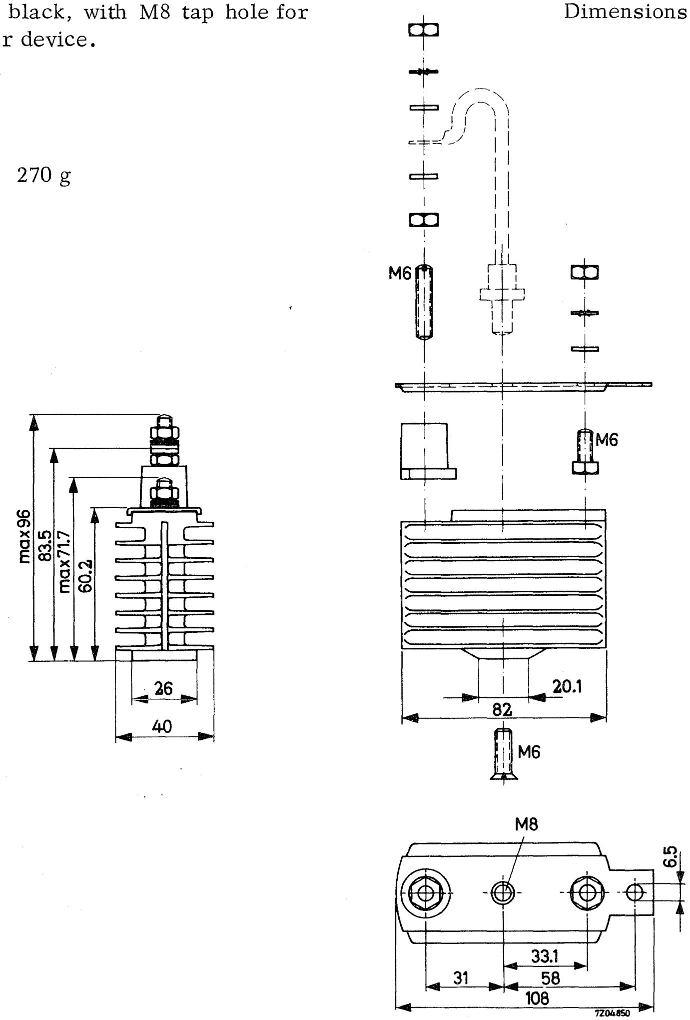


DIECAST HEATSINK

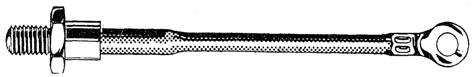
Diecast heatsink of aluminium alloy, painted black, with M8 tap hole for rectifier device.

Weight 270 g

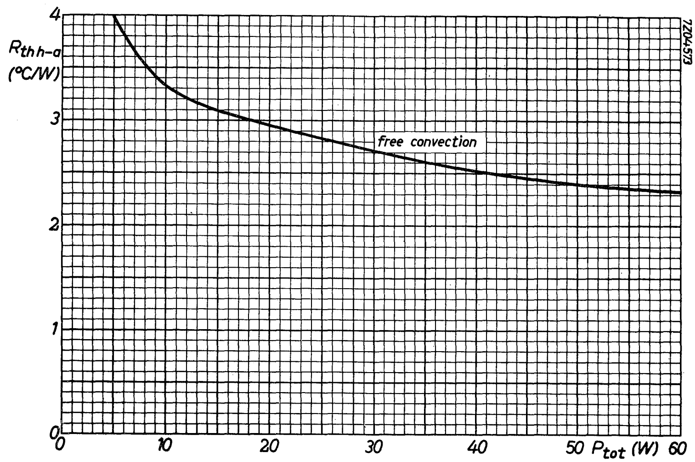
Dimensions in mm

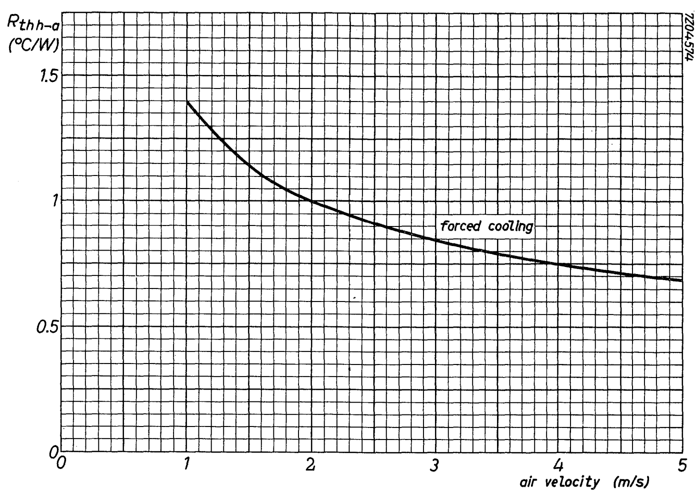


The graphs are valid for the combination of diode and heatsink.



Stud: M8
Mounting base, across the flats: 17.0 mm



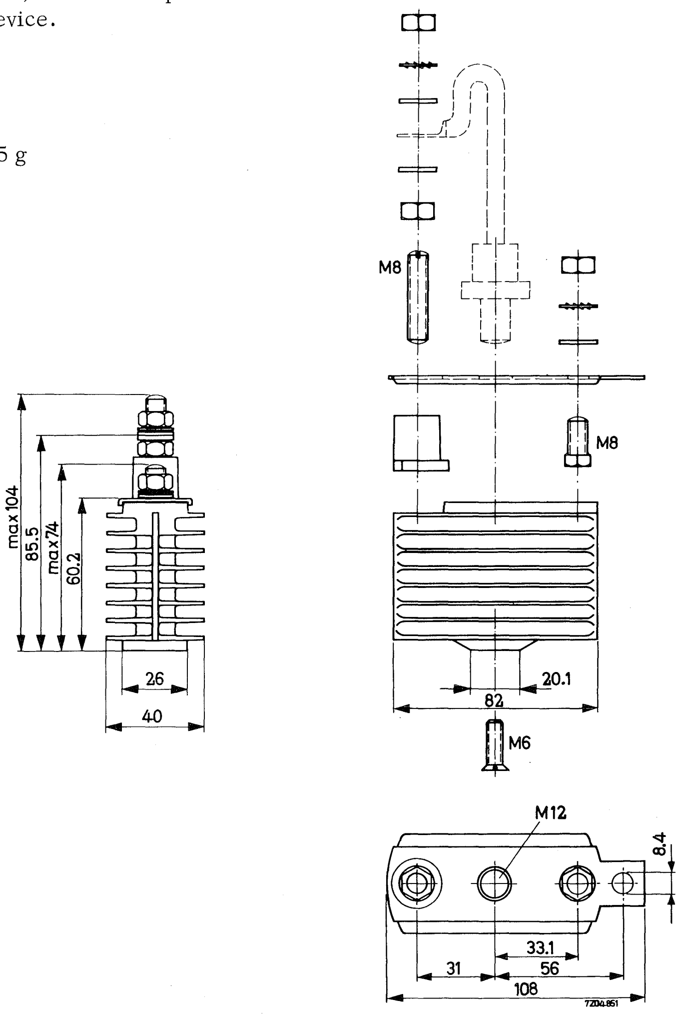


DIECAST HEATSINK

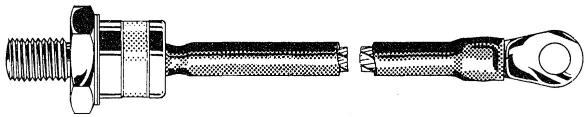
Diecast heatsink of aluminium alloy, painted black, with M12 tap hole for rectifier device.

Dimensions in mm

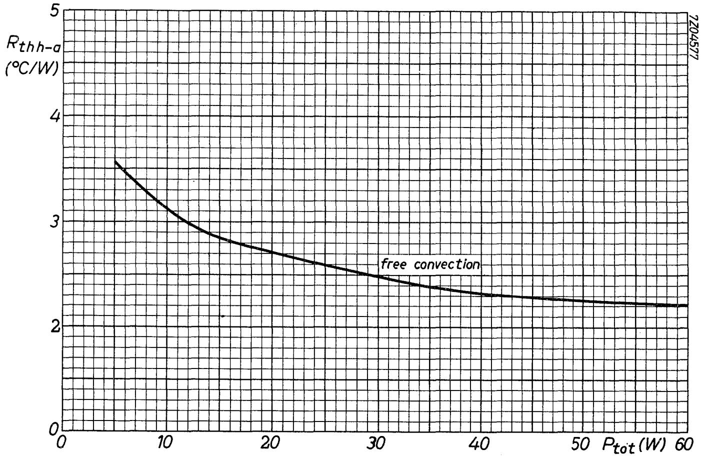
Weight 295 g

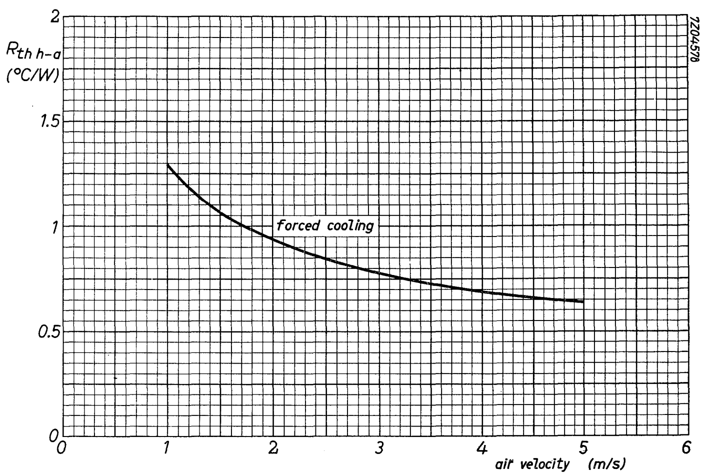


The graphs are valid for the combination of diode and heatsink.



Stud: M12
Mounting base, across the flats: 27.0 mm



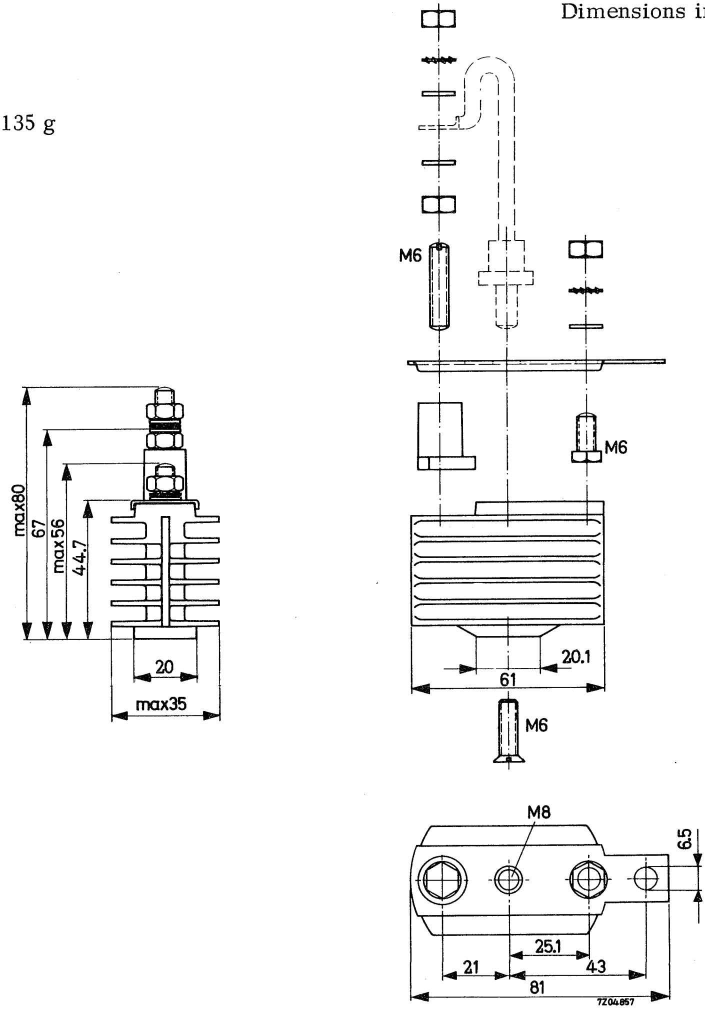


DIECAST HEATSINK

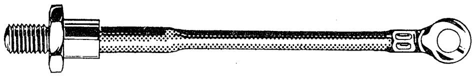
Diecast heatsink of aluminium alloy, painted black, with M8 tap hole for rectifier device.

Dimensions in mm

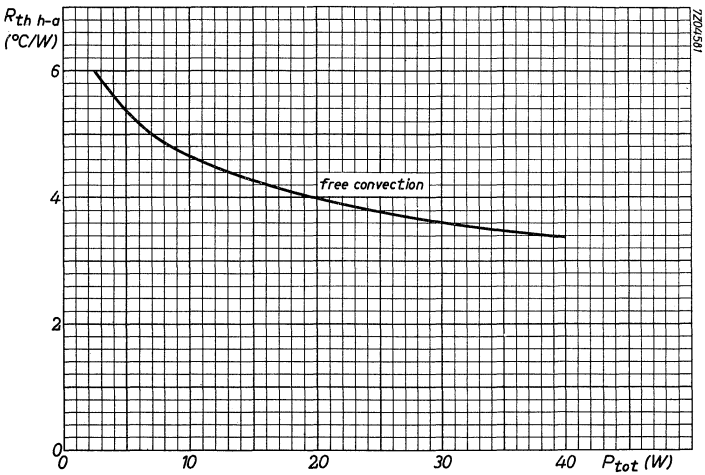
Weight 135 g

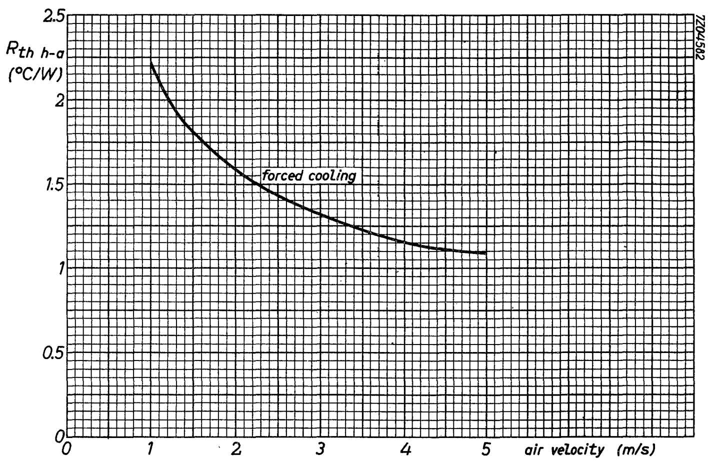


The graphs are valid for the combination of diode and heatsink.



Stud: M8
Mounting base, across the flats: 17.0 mm



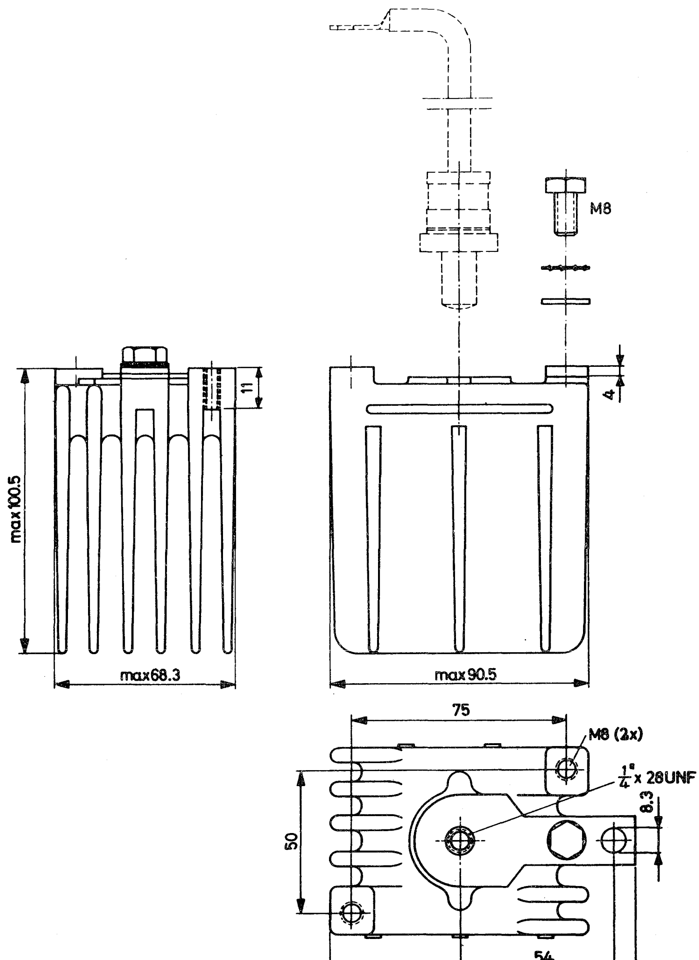


DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with $\frac{1}{4}''$ x28UNF tap hole for rectifier device.

Dimensions in mm

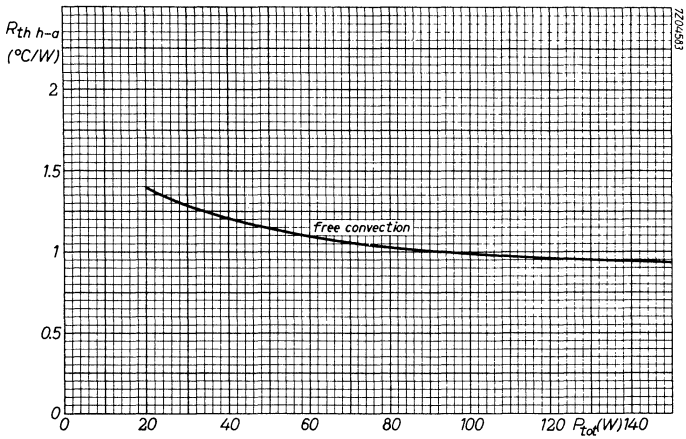
Weight: 690 g

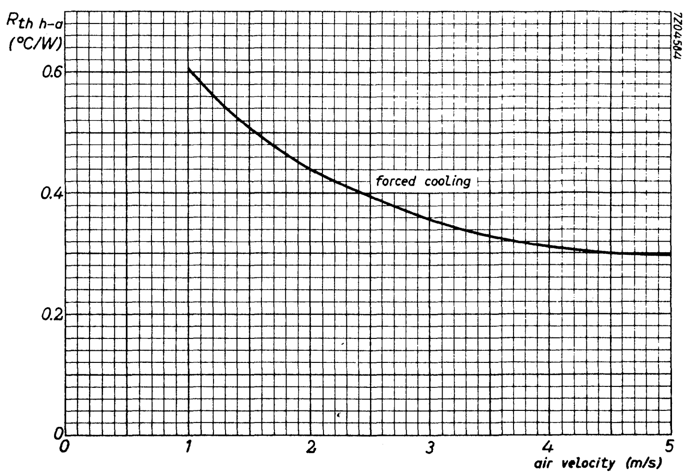


The graphs are valid for the combination of thyristor and heatsink.

Studs: $\frac{1}{4}$" x 28UNF

Mounting bases across the flats: 14.0 mm resp. 17.0 mm



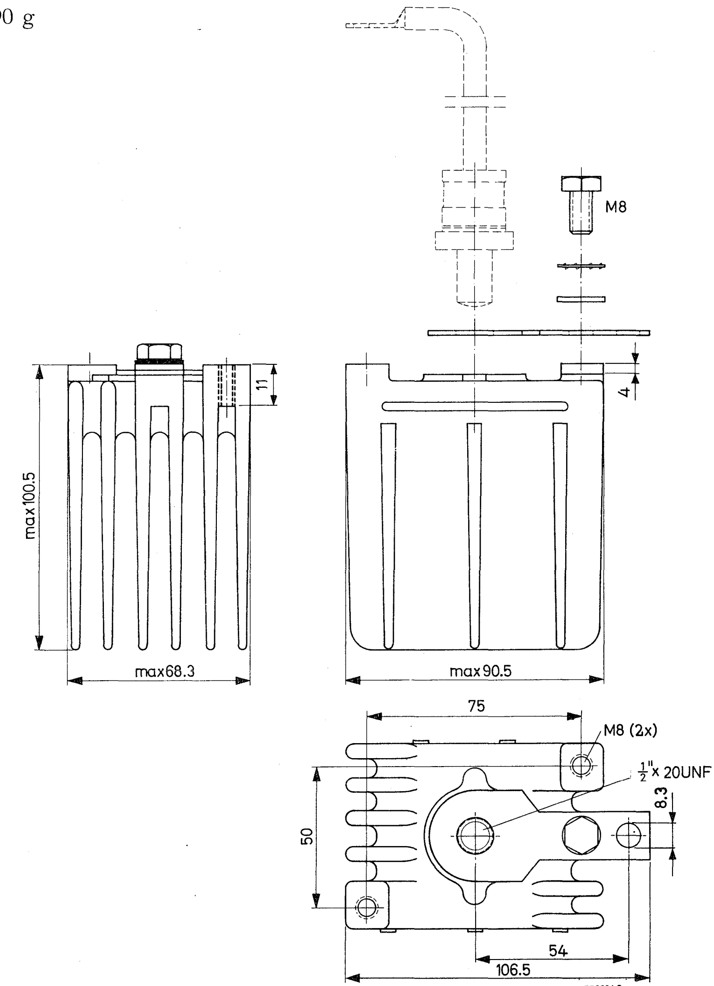


DIECAST HEATSINK

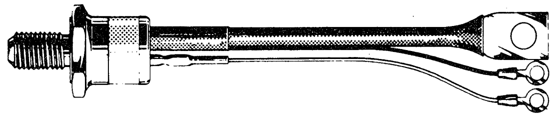
Diecast heatsink of aluminium alloy, painted black, with $\frac{1}{2}$" x 20UNF tap hole for rectifier device.

Dimensions in mm

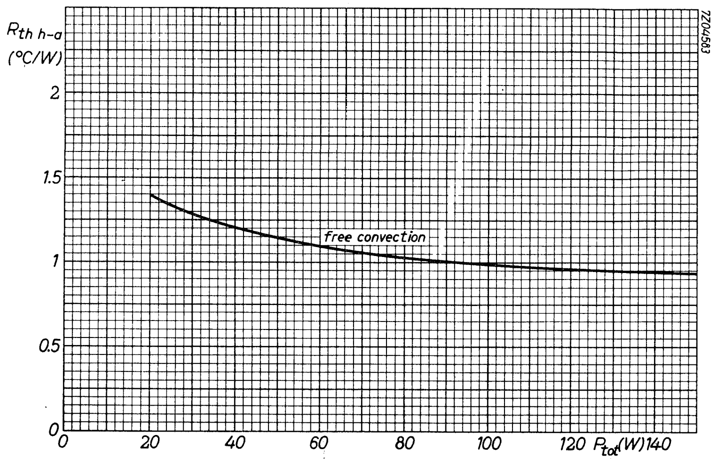
Weight: 690 g

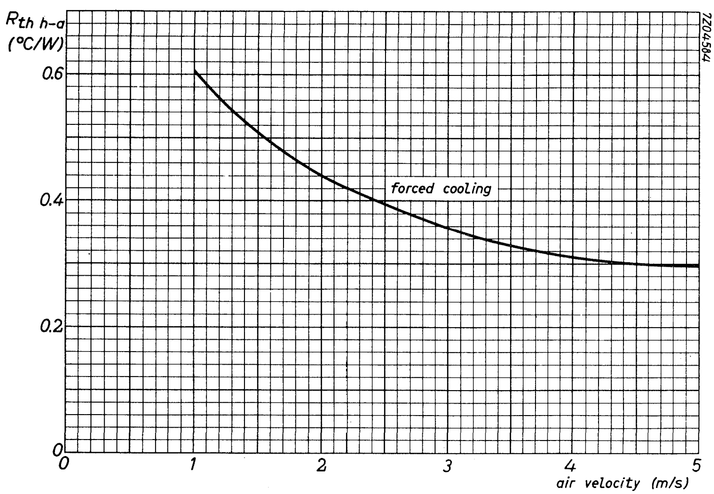


The graphs are valid for the combination of thyristor and heatsink.



Stud: $\frac{1}{2}$" x 20UNF
Mounting base, across the flats: 27.0 mm



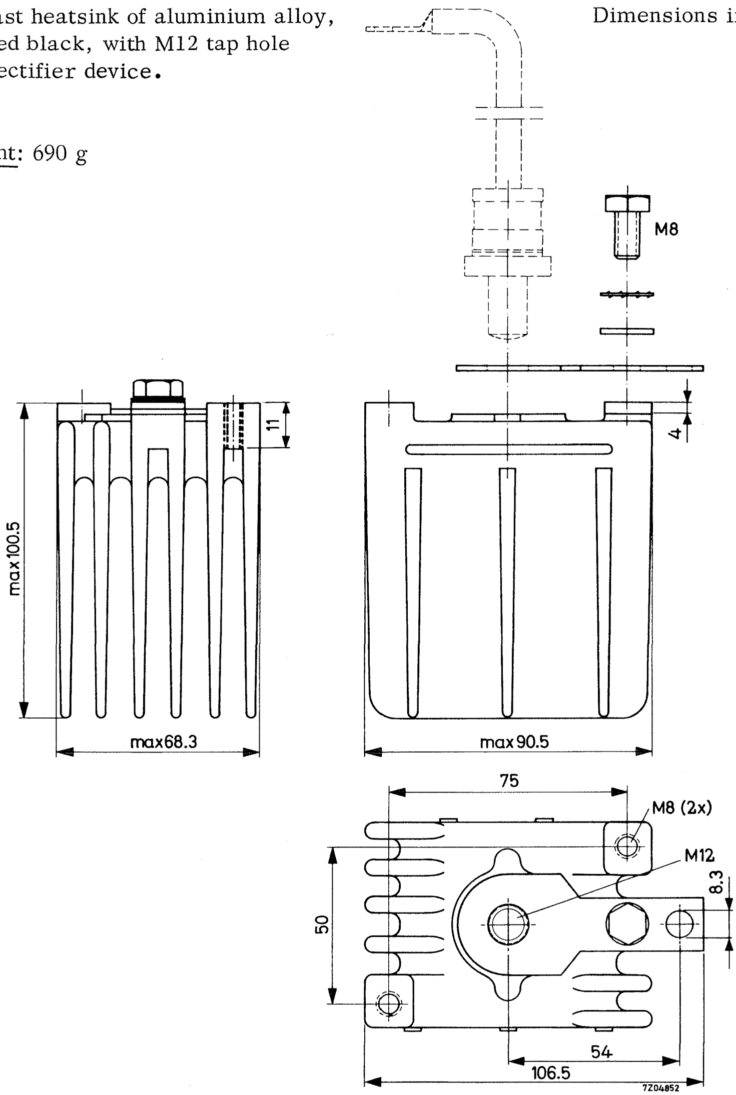


DIECAST HEATSINK

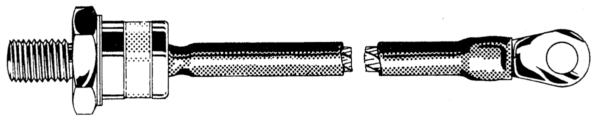
Diecast heatsink of aluminium alloy, painted black, with M12 tap hole for rectifier device.

Dimensions in mm

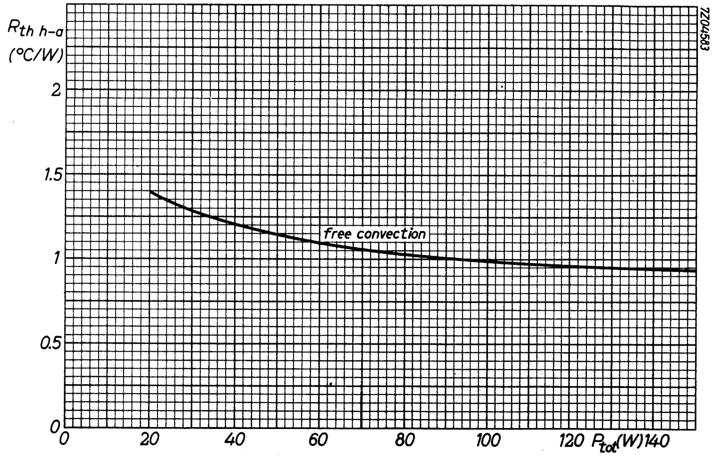
Weight: 690 g

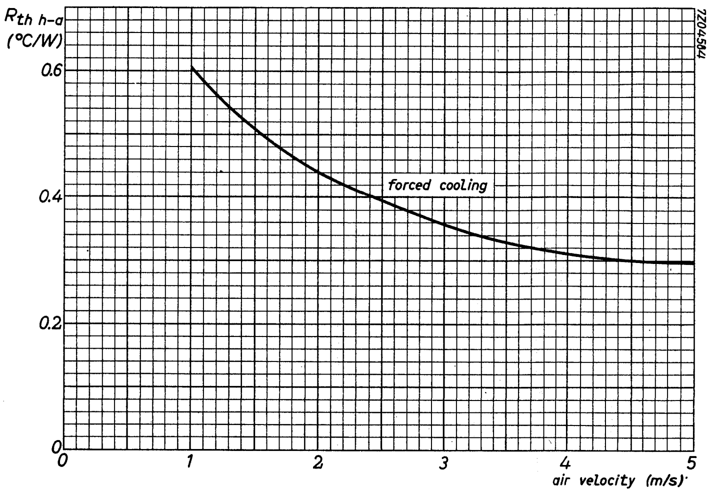


The graphs are valid for the combination of device and heatsink.



Stud: M12
Mounting base, across the flats: 27.0 mm



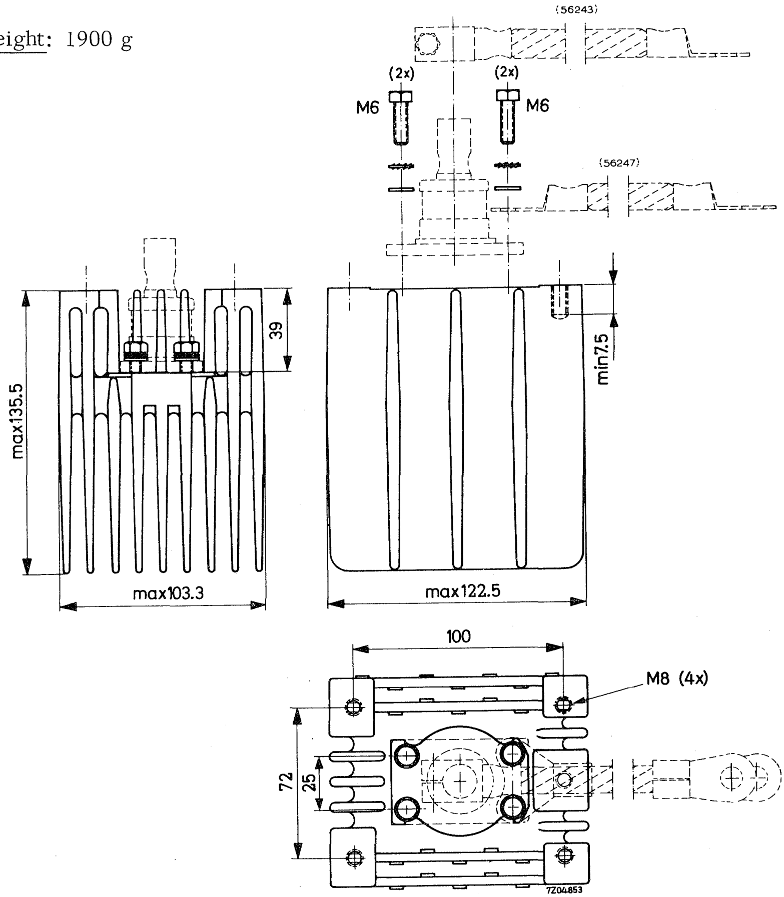


DIECAST HEATSINK

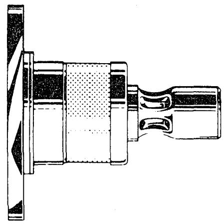
Diecast heatsink of aluminium alloy, painted black, intended for devices with flat mounting base.

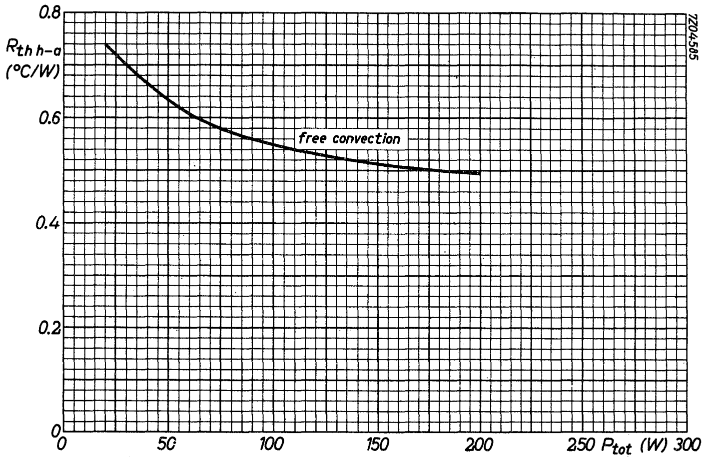
Dimensions in mm

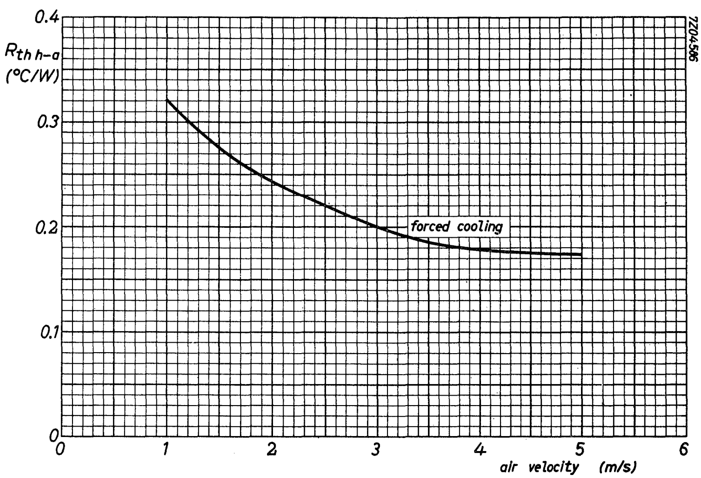
Weight: 1900 g



The graphs are valid for the combination of diode and heatsink.





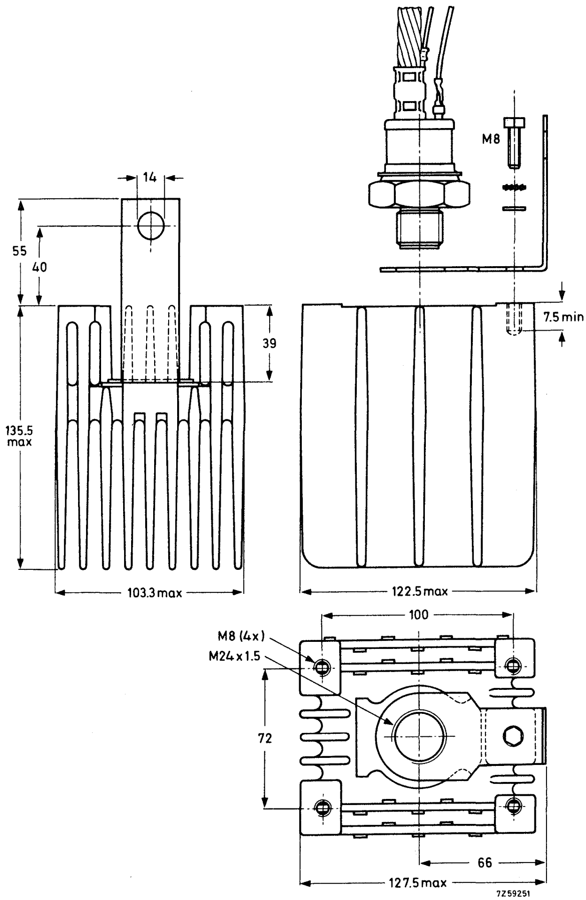


DIECAST HEATSINK

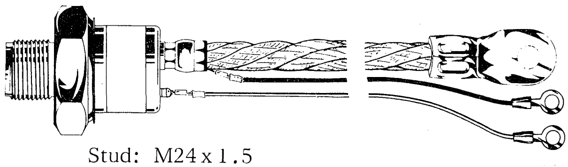
Diecast heatsink of aluminium alloy, painted black, with M24 x 1.5 tap hole for rectifier device.

Dimensions in mm

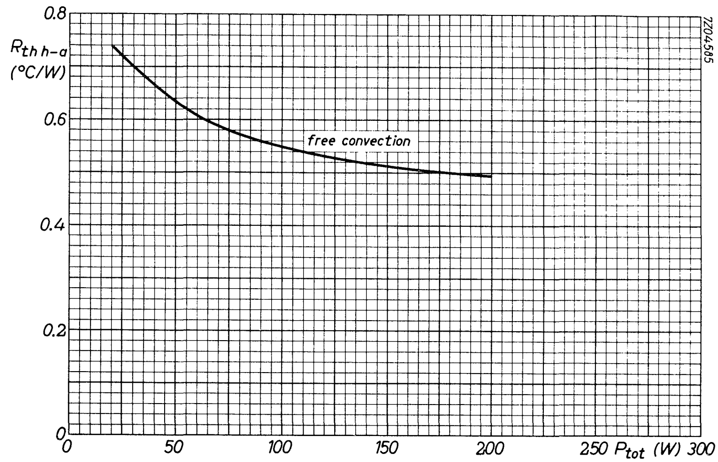
Weight: 1900 g

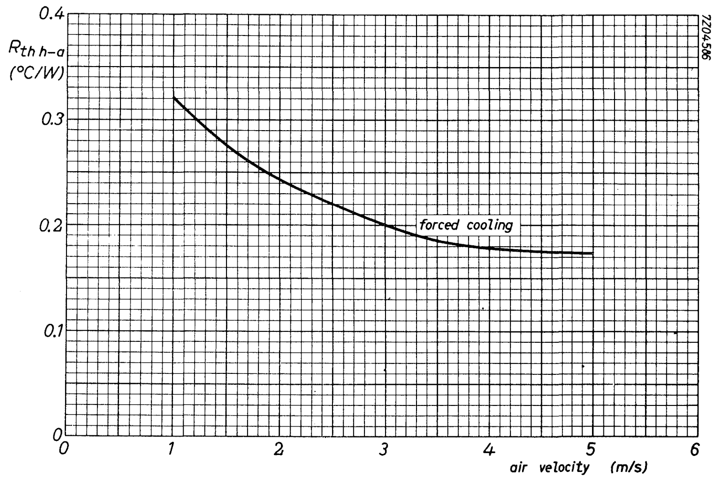


The graphs are valid for the combination of thyristor and heatsink.



Stud: M24 x 1.5
Mounting base, across the flats: 46 mm



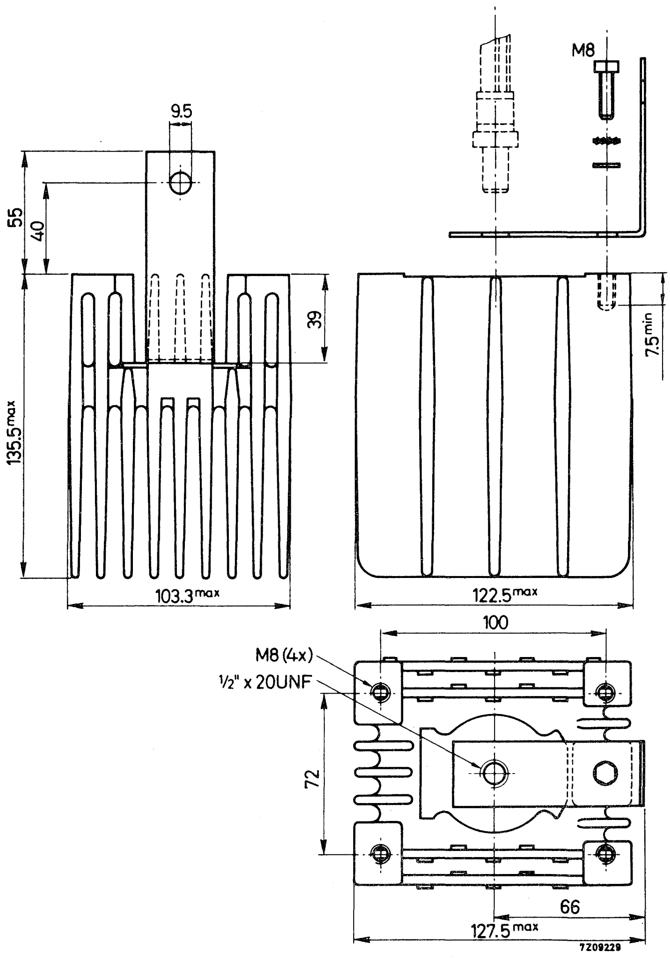


DIECAST HEATSINK

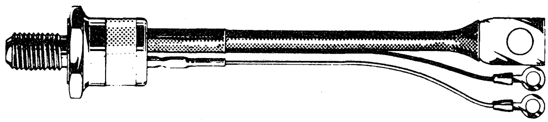
Diecast heatsink of aluminium alloy, painted black, with $\frac{1}{2}$" x 20UNF tap hole for rectifier device.

Dimensions in mm

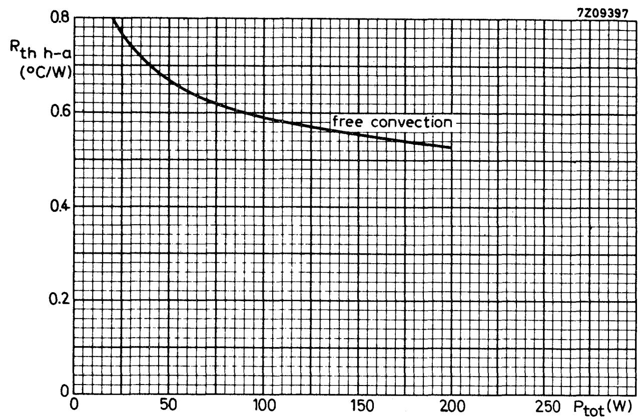
Weight: 1900 g

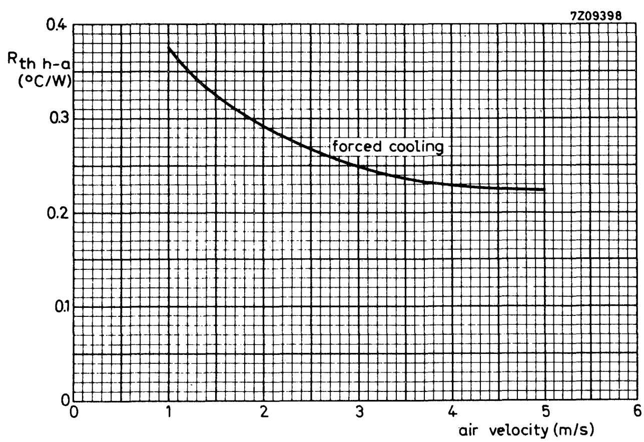


The graphs are valid for the combination of thyristor and heatsink.



Stud: $\frac{1}{2}$" x 20 UNF
Mounting base, across the flats: 27.0 mm



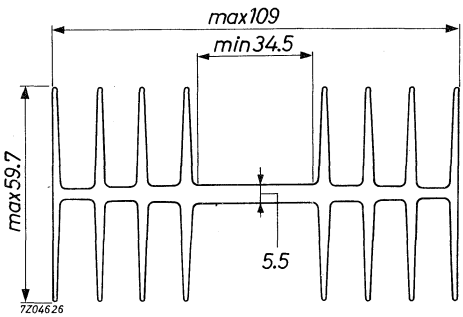


EXTRUDED ALUMINIUM HEATSINK

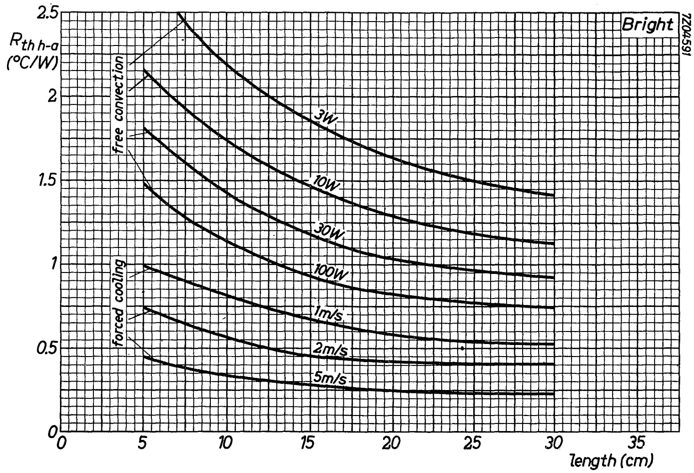
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

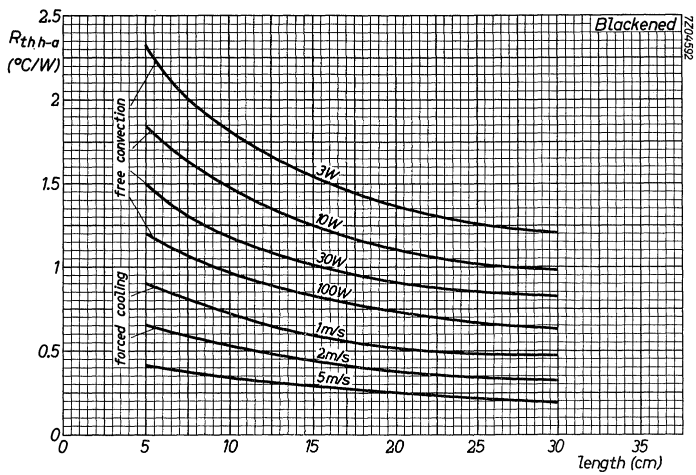
Weight: 4 kg per 1.5 m.

Dimensions in mm



The graphs are valid for the combination of rectifier device and heatsink.

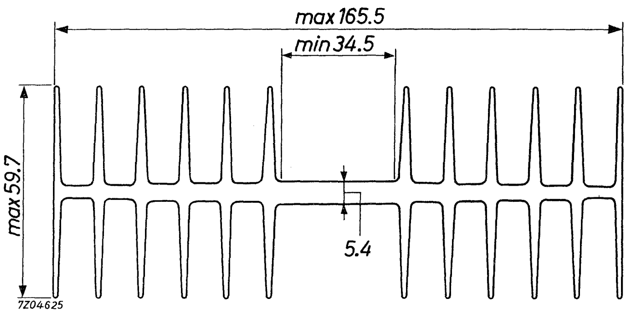




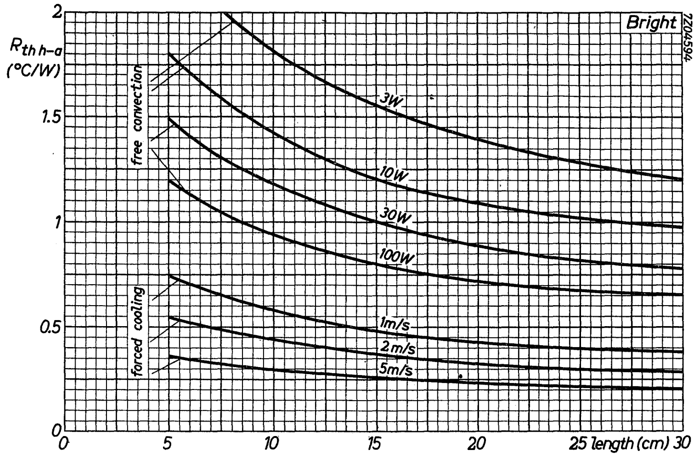
EXTRUDED ALUMINIUM HEATSINK

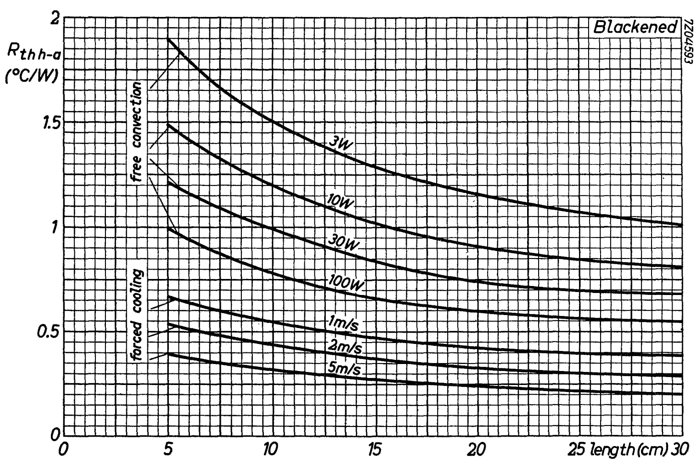
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

Weight: 6 kg per 1.5 m. Dimensions in mm



The graphs are valid for the combination of rectifier device and heatsink.



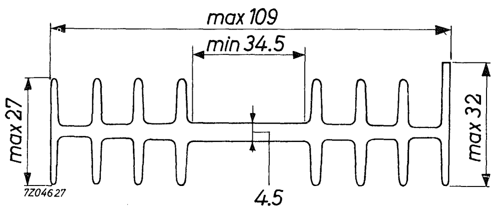


EXTRUDED ALUMINIUM HEATSINK

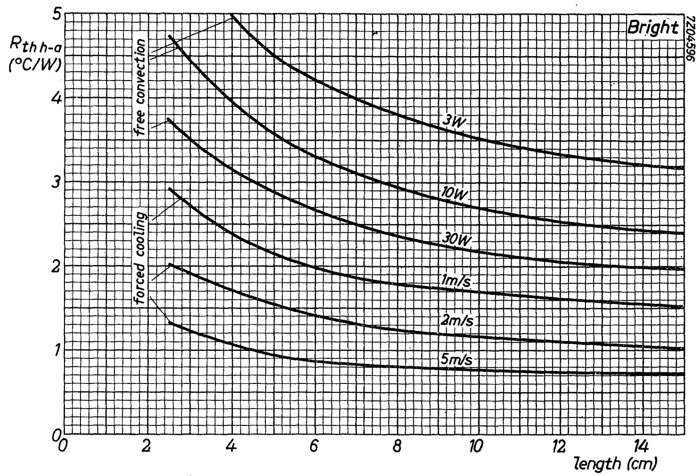
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

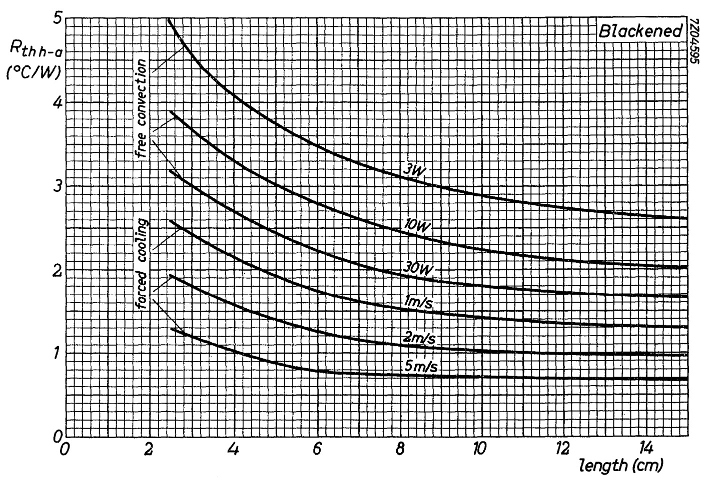
Weight: 2.4 kg per 1.5 m.

Dimensions in mm



The graphs valid for the combination of rectifier device and heatsinks.



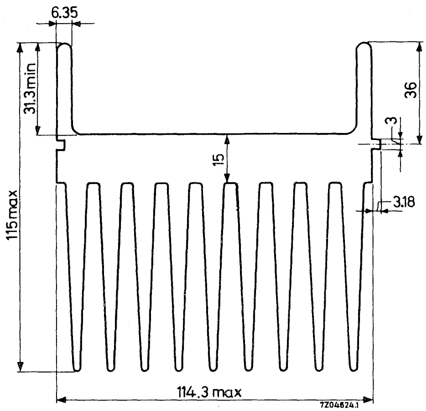


EXTRUDED ALUMINIUM HEATSINK

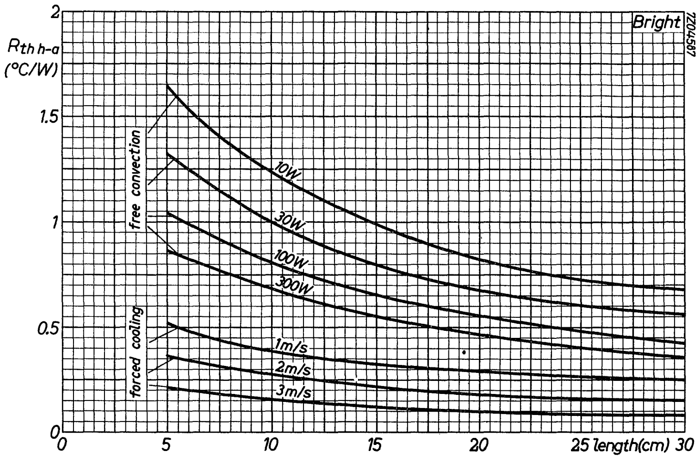
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

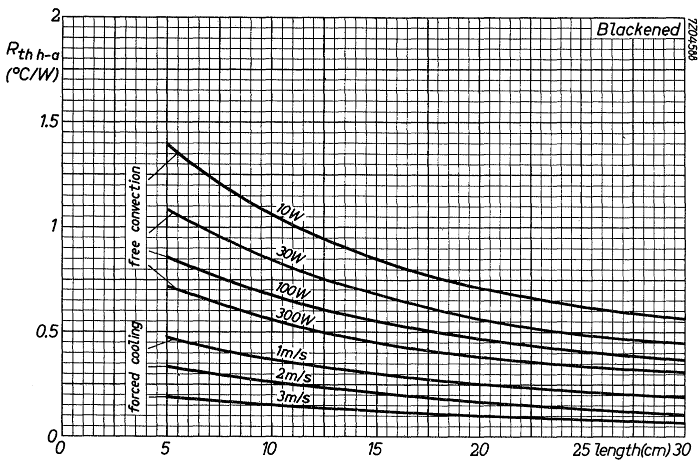
Weight: 16.2 kg per 1.5 m.

Dimensions in mm



The graphs are valid for the combination of rectifier device and heatsink.
For devices with a flat base see over.

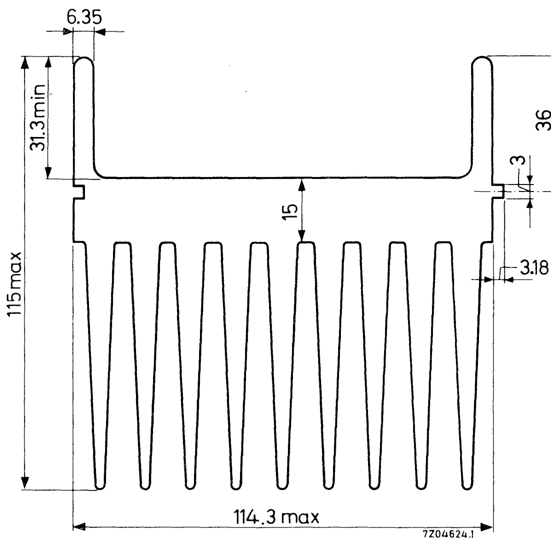


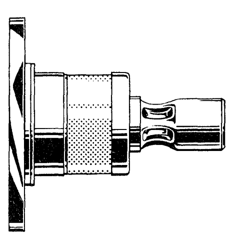


EXTRUDED ALUMINIUM HEATSINK

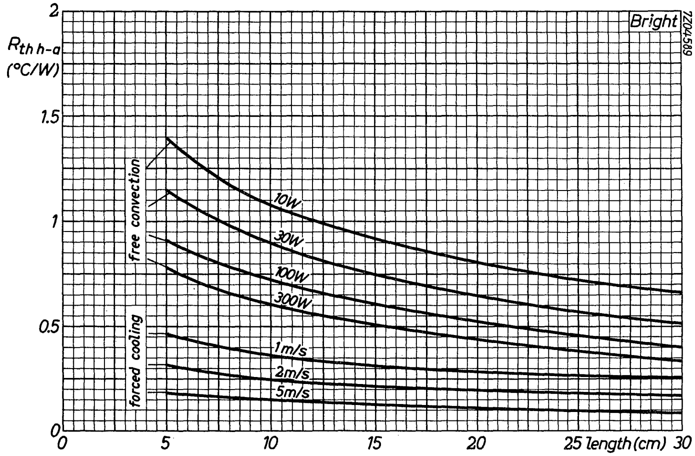
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

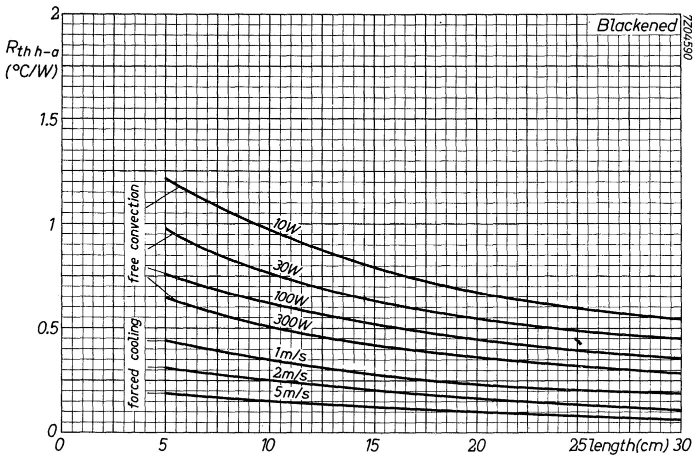
Weight: 16.2 kg per 1.5 m. Dimensions in mm



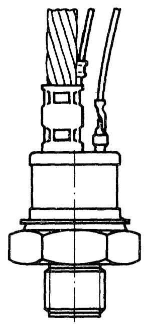


The graphs are valid for the combination of rectifier device and heatsink.
For devices with threaded studs turn back one page.



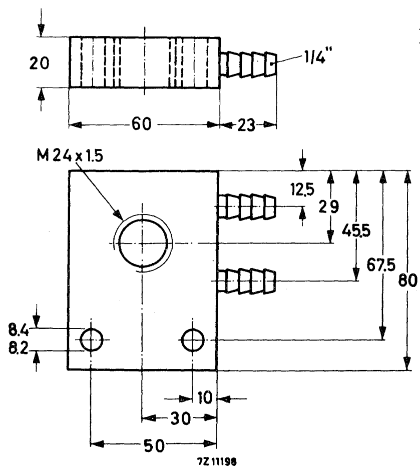


WATER COOLED HEATSINK
for BTX41series

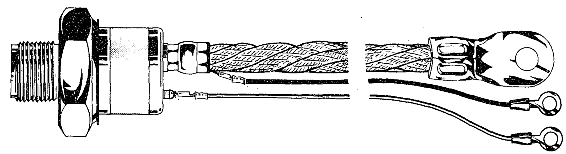


Net weight: 750 g

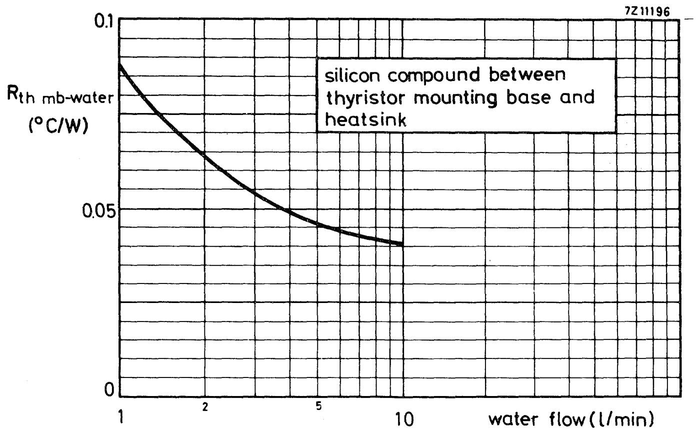
Dimensions in mm

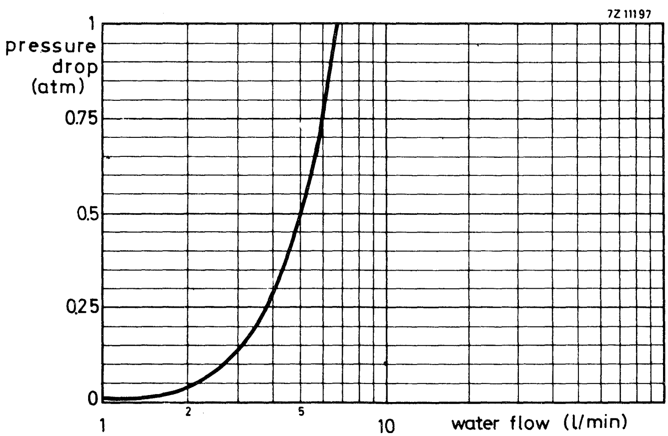


Torque on hexagon: min. 300 kg cm (30 Newton-metres)
max. 400 kg cm (40 Newton-metres)



Stud: M24 x 1.5
Mounting base, across flats: 46 mm





INDEX OF TYPE NUMBERS

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

D = Signal diodes
R = Rectifier diodes
St = Rectifier stacks
Thyr = Thyristors, diacs, triacs
Tu = Tunnel diodes
Var = Variable capacitance diodes
Z = Voltage regulator diodes

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Thyr = Thyristors, diacs, triacs
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A = Accessories H = Heatsinks

Printed in The Netherlands

9399 251 14401